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New Panel-carving Machine.

The accompanying illustration is of a new panel-carving machine, which is especially adapted for raising panels, edge molding, routing, carving, dovetailing, and all the varieties of work in this line made in church, school, and other furniture factories, and in car shops.

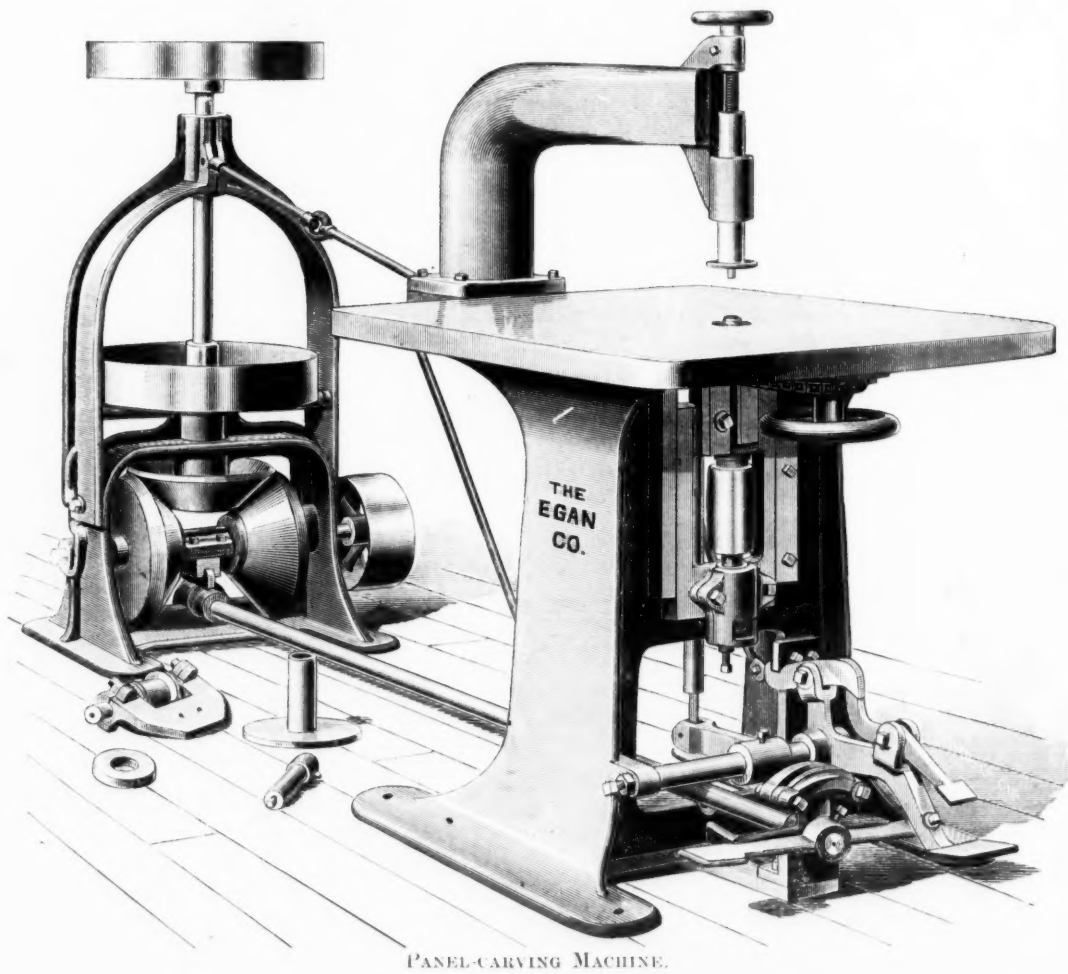
The column is one solid casting, with ample floor space to insure steady running; the mandrel is of steel, running in self-oiling boxes lined with babbitt metal; the boxes are connected, and raise and lower in planed ways, operated by foot power. The mandrel is driven by a patent friction reverse, operated from the front or working end of the machine, reversing the spindle very quickly when necessary.

For paneling, the extension arm bracket is furnished with a stud and thimble placed directly over the center of the cutter; this acts as a guide for the form to rest against; the form is tacked to the panel, and the cutting done from below, so that all chips fall away from the cutter, thereby enabling the operator to do first-class, smooth work.

When the machine is required for molding brackets, a mandrel, cutter and bearings complete are fastened to the extension arm, and driven by a straight belt. When the machine is required for edge molding, both brackets are left off the extension arm, and the machine operated as a standard single-spindle friezer. For dovetailing, the dovetailing attachment is fitted to the table, and the cutter driven by the friction reverse in the usual way, so that, taking everything into consideration, this combined machine will be found one of the most useful and convenient machines ever made for the purpose intended.

The driving pulley on friction countershaft makes 700 revolutions per minute.

The machine is built by the Egan Company, Cincinnati, Ohio.



PANEL-CARVING MACHINE.

In a Railroad Shop.

BY THE OLD MAN.

I visited the main shops of the Buffalo, Rochester & Pittsburgh Railroad recently, at Rochester, N. Y., and found many things of interest. I always enjoy visiting shops and factories alone, for the simple reason that they are not in their Sunday clothes, as is always the rule when a body of visitors are expected, and one is always sure to find things more congenial, and can see things naturally, without restraint.

Mr. Alonzo Dolbeer, the Superintendent of Motive Power of this system, is an old contributor to the AMERICAN MACHINIST, and his methods in vogue in his shop plans and details are thoroughly consistent with all he has ever written or said regarding modern shop practice.

The wood-working machinery, which was at one time in the same room with the machine tools, has been removed to a new building completely isolated from all others, which Mr. Dolbeer very appropriately terms his planing-mill. This building is very large and roomy, being square and having two stories; the ground floor, having two tracks running through it, has the heavy planers, matchers and saws grouped about in such positions that there is no backward operation of the lumber from its entrance as raw material until it leaves for the car shops as finished stuff. One double surfacer in this shop was turning out boards at the rate of 76 feet per minute. One-half of the second floor is used as storage for odd patterns, while the other half is the pattern shop, the windows of which are set very high on the sides, thus assuring the workmen a nice even light, and making a very cool place in summer. The inside of this room is ceiled with waste matched pine and varnished, giving it a very clean and neat appearance, beside making it a very warm place in winter. The tools usually found in pattern shops are here, and are well kept. A combination saw built at these shops, designed by J. C. Corbett, foreman pattern maker, and used here, possesses some very admirable features. While the two saws are independent, by putting a rip-saw on the cross-cut arbor they can be used in unison for paralleling lumber to advantage. Each saw arbor is raised or lowered by means of a hand-wheel in front, and the arbor travels in an angular arc at right angles to a line through the counter pulleys, which are attached to the opposite end of the machine. The frame and table are of iron, and make a very neat, tastefel appearance. Pipes from every machine in the building to the fuel room adjacent to the boiler room, convey all shavings and saw kerf away, leaving the floors and machines clean. The arrangement of the boiler for supplying steam to the large engine driving this plant is interesting. It is of the ordinary locomotive type, and is elevated about five feet above the floor, the leg resting on the back end of a brick furnace or fuel burner about twelve feet long, and having an opening upward directly under the fire box and of the same size. This makes a perfect combustion chamber of the original fire box of the boiler, and the long brick furnace gives ample room for consuming long pieces of car sills and other waste materials from the repair shops, of which there always is a surfeit in all such shops, without any expense for sawing it up to shorter lengths. Goodly sized double fire doors at the front end make it an easy matter for the fireman to handle the heavier refuse, while a small blower is piped so as to supply a constant flow of shavings when desired, from the fuel room through an opening just over the fire doors. Under the usual conditions to be found around most railroad shops, the smoke arch would be constantly red hot; by this arrangement it remains practically cool, showing that combustion takes place before it is done with its work, instead of afterward. This method of furnace construction is in very common use among the saw-mills in Michigan, along the St. Lawrence River, and in the Canadas, where coal is scarce, and refuse of all sorts must be used, and it gives universal satisfaction.

In the machine shop I found the tools all busy, and, with but one exception, all are practically new and in very good condition, the only drawback being that there are not enough of them. For instance, there is only one tire-turning lathe on the whole system, and remembering that the company owns one hundred and sixteen engines, the great majority of which are moguls and ten-wheelers, that tire lathe must run about twenty-four hours a day the whole year round to keep the wheels turning on the rails. The tool room contains a milling machine, small lathe, and a Brown & Sharpe universal grinder, and although cramped and crowded, it is a picture of neatness. Two machinists are busy here keeping tools in repair and making new ones. Some taps and reamers just finished were as perfect as any I ever saw made by the manufacturers of those articles; even to the color in tempering they would compare very favorably with any Morse makes. This is far above the average locomotive shop practice in regard to taps and reamers; as a rule they are a sort of fatherless and motherless monstrosity, hated by their user, despised by their makers, and only permitted through the ignorance of correct methods by those in charge.

I saw one four-cylinder compound in the shop for general repairs, and, from close inspection of the valve chambers and the guides and crossheads, I thoroughly satisfied myself that the four-cylinder type of compound locomotive is nothing but a beautiful experiment, and in the end a very costly one. The cost of repairs is far in excess of saving in fuel. The present four-cylinder type varies.

The car wheel department, although seemingly small, is so arranged as to be one part by itself. The wheel press, wheel borer and axle lathe are so conveniently grouped that only four men are employed in loading and unloading all wheels, and also running the machinery. In planning for this work, the customary derrick or traveling crane was omitted, and a long pit dug and track laid in it so as to hold three or four cars, and bring their floors on a level with the shop floor, consequently no time is lost by employes wrestling with pulley blocks. As the road has over 7,000 cars, it would be pretty hard for a more economical handling of work to be displayed. The machine shop is driven by a Triumph compound engine, made in Cincinnati. It is a triple-cylinder affair, and has broken its crankshaft three times. Mr. Dolbeer was having another one turned up from a solid forging, so as to be prepared for another breakdown, I suppose. I don't think it is an economical method of compounding, except for a new engine.

To illustrate the wide difference of opinion existing in the minds of our railway shop managers: In these shops are two radial drills—one a Niles, the other a Pond; both are busy all the time, and are proven important and valuable machines. Two other gentlemen occupying the same posi-

tions on other roads as the one in charge here, only having control over vastly larger shops and systems, have told the writer that they could not see the use of such tools, and would not have them around if it were possible to avoid it. The only philosophical explanation I could ever figure out for such a variance of ideas was the fact that the two were educated in an office, while this man is a practical mechanic, and knows from practice and actual contact what is good and what is not. The freight car repair shop, situated far enough away from the other buildings to make matters safe in case of fire, is so peculiar in its antique construction that I will not attempt to describe it. Within its walls, which will hold only eight freight cars, lies the capacity for repairing and overhauling 120 cars per month, and when it is known that "repairs" sometimes means everything new above the trucks, this long, narrow building, with two tracks running through it, is a veritable bee-hive during the busy season. The upper story of this shop is also utilized, and here all the upholstering is looked after, passenger car cushions and seats are renovated and made new, also the supplies necessary to upholstering are kept here.

All of the various shops and buildings are isolated, and are also heated by steam from a central point, the steam being taken at its highest temperature to the highest point necessary in the building, and from there carried to the tops of the steam coils located around the sides, and drained away at the bottom of the coils. Examination showed that the top coils in every building were too hot to touch with the hand, while the lower ones were just warm; the steam is taken from the exhaust of the planing-mill engine, assisted by live steam from the boiler previously described, and fired with waste wood. The practical economy exhibited in heating this large plant does not require a diagram, and is worthy of emulation.

This being a coal road, the black diamonds are only $1.25 per ton, and one might think economy was being strained just a little bit, but Mr. Dolbeer's idea is, "A ton of coal saved is a ton of coal earned," which gives him a little more allowance for internal repairs on his motive power, instead of trying to make his engines pull their trains simply by using paint and putty.

On the Cultivation of Inventive Capacity by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

I shall be able in this article to include all the remaining solutions of the problem given out in the issue of July 28th. Among the numerous solutions that have met all the conditions and restrictions of the problem, there have been also quite a number that could not be accepted as strictly correct. Had it not been that it would have established a precedent for inaccurate work, I should have been tempted to have published some of these abortive attempts, because they were so ingenious and mechanical, albeit not meeting the conditions named. They indicate on the part of those who contributed them, either inattention in reading the statement of the problem, or an idea that rigid adherence would not be exacted.

This last idea is a mistake often made by young mechanics, draftsmen and engineers in the practical business of the shop, the drawing room, and the field. "This is not exactly what the old man required" (meaning the foreman, the superintendent or the chief of the surveying party), "but I guess it will do just as well," is a mental soliloquy that has earned many such a smart fellow a sharp rap upon the knuckles of his vanity. Superintendents, foremen, and chiefs of engineering corps are not wont to be patient with either willful or heedless departures from explicit directions. The best advice any young man can have in entering upon the duties of active service is to follow directions implicitly, unless impossible to be followed, and to be very careful not to challenge orders as impossible to execute unless armed with convincing evidence of the impossibility. His chances will be much better if he modestly confesses his inability to see clearly how the thing required can be done. In most such cases a few words of explanation will clear away fancied difficulties. It may happen, also, that in the attempt to explain, the superior who gave the orders will find that he has required something that is incompatible with another es-

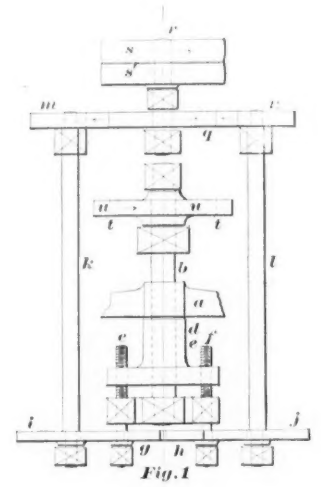


Fig. 1

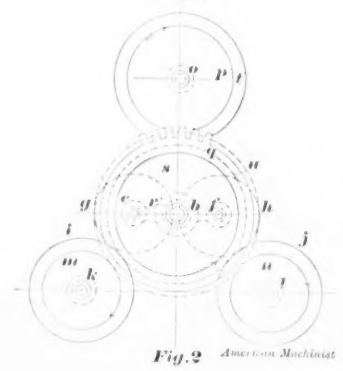


Fig. 2 American Machinist

sential requirement. In such a case the subordinate will be fortunate if he has not used the word "*impossible*," but has let "the old man" find it out himself. Probably the oversight will not be acknowledged, though there are still some men left in the world who are honest and frank enough to admit their own errors. The young man who has been "wise as a serpent" will get credit for his wisdom, as well as his ability to "spot" weak points all the same, and will probably be secretly amused by the way "the boss" lets himself down easily, with, in substance, "I guess I won't bother about explaining that to you, as I have thought of a better plan, anyway." Whereupon, in a little while, our tactful young friend will receive a sketch to elaborate, or orders to execute, which he will, perhaps, recognize as exactly what he had at first, minus the impracticable feature. I trust that, having so far shown himself adroit in dealing with a weakness of human nature that even great men sometimes display, he will take the revised sketches or orders without the least indication that he recognizes them as other than entirely new, and that he will proceed to execute them with skill and dispatch. So shall his chances for advancement be brighter than those of his less adroit competitors.

A solution which, if my memory does not betray me, introduces a mechanical feature not shown in any other solution offered to the problem of July 28, has been sent in by Mr. Charles P. Smith, of Lynn, Mass. It is illustrated in Figs. 1 and 2, Fig. 1 being a front elevation, and Fig. 2 a plan. The distinctive feature of the device is the employment of a screw movement for raising and lowering the hub. The figures do not show framework for supporting bearings, the bearings being indicated by the ordinary conventional cross.

The hub *a* is splined to the shaft *b*, and it rests on the sleeve *d*, which is raised and lowered alternately by the screws *e* and *f*, *e* being threaded right-handed, while *f* is a left-handed screw, and both having the same pitch.

These screws are operated first in one direction and then—after a period of rest—in the reverse direction by the gear wheels *g* and *h* keyed to the screws and respectively intermeshing with the gears *i* and *j* keyed to the shafts *k* and *l*, the manner in which their motion is reversed being explained below.

At the upper parts of the shafts *k* and *l* are keyed to them the gears *m* and *n*; and to the upper part of a shaft *o* placed directly in the rear of the shaft *b*, and therefore shown only in plan, Fig. 2, is keyed another gear *p*.

The gears *m*, *n* and *p* are all in the same horizontal plane as the segmental gear *q*, which meshes with them successively, each turning a part of a revolution, less than a quarter turn in this instance, to meet the requirements of the problem, but which may be made to turn any desired distance, according to the number of teeth in *q*. The gear *q* is keyed to the shaft *r*, to which also, at the upper end, are keyed the fast and loose pulleys *s s'*.

On the shaft *o*, at a distance below the gear *p*, is keyed a gear *t* that intermeshes with the gear *u* keyed to the upper part of the splined shaft *b* that turns the hub.

The gears *g* and *h* on the screws *e* and *f* also intermesh with each other, although, as shown in the plan, only circles on which the teeth stand are indicated, and they might appear to be independent of each other.

Now, suppose the fast pulley *s* to be turning in the direction of the arrow marked upon it; the directions in which all the other wheels will turn will then be as indicated by the arrows. The screws *e* and *f* being geared together will turn in opposite directions, but being one right while the other is left threaded, both will act together in lifting or lowering the sleeve *e* on which the hub *a* is supported. The gear *q* being segmental will operate the gears *p*, *m* and *n* alternately, a period of rest occurring for all these last-named gears between each rotation. The screws, when the segmental gear *q* meshes with *m*, will act together to lower the sleeve, and when the gear *q* acts upon *n* they will act to lift it, and with it the hub that has previously slipped down on the shaft *b* as the sleeve was lowered.

In a former article I have pointed out the objections to mutilated or segmental gears, which hold good whenever the motions of the parts are not limited by positive stops. The use of screws for lifting and lowering, as shown by Mr. Smith, is an excellent way of effecting the object in a case where the hub and its attachments being of great weight are required to move up and down only through a small distance, and with very moderate velocity.

Figs. 3, 4, 5, 6 and 7 are respectively a side elevation and details of a solution communicated by Mr. W. E. Clark, of Monmouth, Ill. Mr. Clark has made his sketches as though the problem required that the horizontal movement of the hub should be through one-fourth the entire revolution; but he explains, as will be seen, that the parts effecting this movement may be made to effect rotation through any arc less or greater than this.

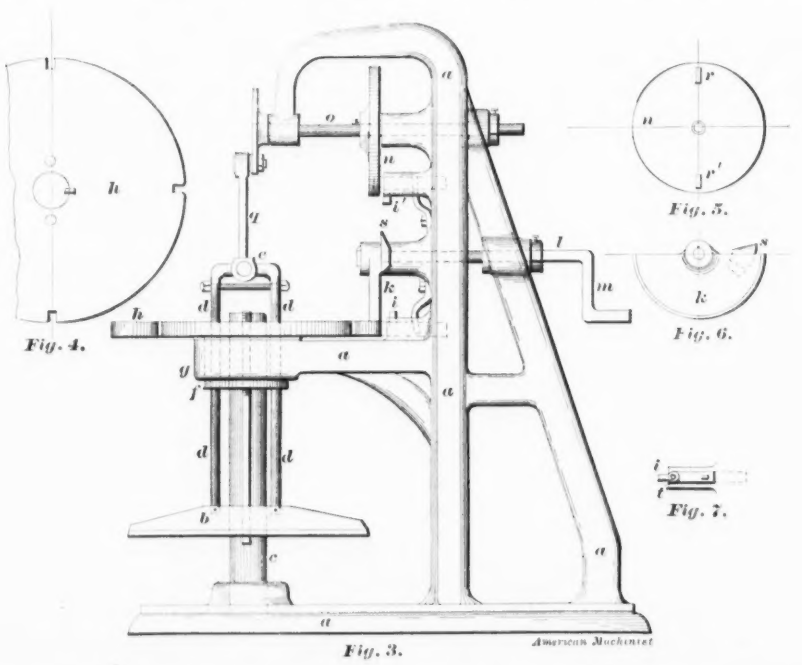


Fig. 3. American Machinist

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

In Fig. 3 *a* is a frame that supports all the working parts, and *b* is the hub splined to the shaft *c*. To the hub is attached the yoke *d*, having at the top the ball-and-socket joint *e* to which the link *q* is connected. To the upper end of the shaft *c* is fitted a sleeve *f* that turns in the boss *g*, and above the boss is a notched disk *h* also fitted to the shaft. The yoke *d* slides up and down freely through the sleeve *f* and disk *h*, carrying with it the hub, the latter also sliding vertically on the shaft.

At *i* is a sliding pawl (shown in detail in Fig. 7) that successively engages the notches and positively limits each horizontal rotative movement of the disk *n* (shown in detail in Fig. 4).

The friction wheel *k* (shown in detail in Fig. 6) is attached to the shaft *l* of the crank *m*. Directly above it is the friction wheel *n* carried by the shaft *o*. On the extremity of the shaft *o* is keyed the crank disk *p* that operates the link *q*. The latter has a ball bearing at the lower end fitted to the socket *e*.

At *i'* is another sliding pawl that engages in the slots *r r'*, shown in the face view of the wheel *n* in Fig. 5, and which locks this disk to hold the hub either in lower or upper position, as the case may be. On the wheel *k* is a lug *s* that has an inclined plane surface, shown in Fig. 6. The perimeter of the wheel *k* is fitted with rubber to increase its friction. Each of the pawls *i* has a projecting lug, as shown in Fig. 3, and in Fig. 7 at *t*.

In operation, when the crank is turned, the lug *s* strikes the lug *t*, and forces the pawl *i* out of the notch in the disk which it has engaged, just before the friction edge of the wheel *k* reaches and presses upon the disk *h*, to rotate the latter. Similarly the lug *s* strikes the lug *t* on the pawl *i'* just before the period of lowering the hub, and also just prior to its elevation, in either case just before the friction wheel *k* comes in contact with the wheel *n*. The wheel *n* has the same radius as the wheel *k*, but is not cut away like the latter.

The operation of this mechanism is meagerly described by Mr. Clark, but it appears to me that it must give a horizontal rotative movement to the hub in the lower position.

Thus, the wheel *k*, first acting upon *n* to lift the hub and lock it by means of the pawl *i*, then passes on down toward the disk *h*, the hub meanwhile remaining at rest in the upper position. On reaching and unlocking the disk *h*, the wheel *k* next gives the hub its rotative movement in the upper position, then being disengaged from *h* it next unlocks the wheel *n*, turns the latter, lowers it to the first position, where it remains at rest till the wheel *k* again reaches, unlocks and turns the disk *h*, thus giving the hub a rotative movement in the lower position. If I am right in this analysis of the movement, the solution is redundant,

giving a motion not called for, and therefore presumably restricted. If I am wrong, I shall hope to be set right by Mr. Clark. I must here repeat the objection to friction wheels, viz., their liability to lost motion, which, I think, would cause trouble in a movement of this kind.

Mr. G. W. Phillips, of Providence, R. I., sends in what is probably a correct solution, but his explanation and drawing do not altogether correspond in the letters of reference. The drawing, executed in very light penciling on dark yellow paper, is so difficult to follow in connection with the description, that, much to my regret, I am forced to abandon the intention to reproduce it.

Readers will remember a very simple and mechanical solution contributed by Mr. Albert D. Colburn, of New Haven, Conn. This gentleman has also contributed another solution, shown in a very rough sketch, by which a single lever, actuated alternately first in a vertical direction and next in a horizontal direction, effect first the elevation of the hub, next the period of rest, next the horizontal rotative movement with a positive stop, next the lowering of the hub, followed by a period of rest, this, the required cycle of movements, being repeated indefinitely by the rotation of a single cam with a groove in the perimeter, the fulcrum of the lever being a universal joint. The end of the lever that operates the hub is attached to the hub by a ball joint in a collar fitted to the hub in such manner as to permit a horizontal rotative movement on the hub; and this collar carries a pawl that engages in notches in the hub to rotate the latter, as required. The details of this excellent solution are so imperfectly shown that, though I felt very desirous to illustrate the device, I could not feel justified in taking the time necessary to completely work them out. The device is unique; nothing like it has been sent in by any other contributor.

I have received a letter, under date of November 18, from Mr. Walter Gribben, of Brooklyn, N. Y., who, it will be remembered, has previously contributed an excellent solution and analysis of the motions possible in the use of his device. In his letter he states that in Mr. Neate's solution both myself and Mr. Neate seem to think the stops limiting and rendering positive his ratchet motion are new; and he adduces examples of an old form of such a stop, together with some modifications used in his own practice, to show that such a device is old, although he admits that he has never seen it in the precise form shown by Mr. Neate.

In discussing this feature of Mr. Neate's solution, I did not mean to be understood that a stop device for a ratchet movement was new *per se*. I only meant that it was new in the form shown by Mr. Neate, and I think that gentleman himself did not mean to claim anything more than this.

Mr. Gribben also points out a discrepancy between the drawing and the description of Mr. Neate's solution. I quote his criticism:

"The text says the stops *R* are attached to the frame *H*. If that were so, they would prevent the rotation of the ratchet entirely. To be effective they should be attached to the part carrying the pawl, and this appears to be the way they are shown in the cut."

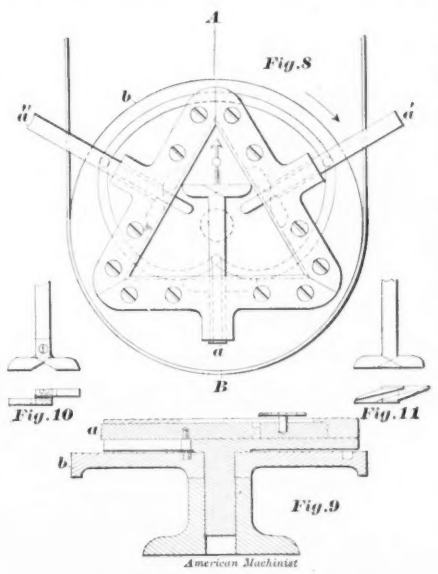
It is quite within the limits of possibility that the defect pointed out by Mr. Gribben did not originate with Mr. Neate, but was an oversight in the preparation of the text for the press. Having returned the original papers to the editor of the AMERICAN MACHINIST, I cannot now determine whether the slip should be charged to my account or not.

A reminder of the triangular movement problem has come to hand in the shape of another solution, contributed by Mr. J. K. Love, of Waterbury, Conn., which is so unique in character that I shall accept his apology for its late appearance, and present it herewith in Figs. 8, 9, 10 and 11.

Of this solution Mr. Love writes, under date of October 31:

"It may be a little late in the season for sending in solutions of the triangular movement problem, but as this one is unlike any that has been shown, and therefore no infringement, I thought I would send it in. Although I think you will easily understand this movement by referring to the drawing, I will write a few words of explanation.

"Fig. 8 is a plan of the apparatus. The number of moving parts exclusive of the needle and its triangular support are four, which is the limit, I believe. There are three T-shaped slides, *a a' a''*, the duty of which is to move the needle-block in the required triangular path. This is accomplished by means of the cam *b*. This cam is divided into three equal parts. In the position of parts shown in Fig. 8 we will suppose the cam to be moving in the direction of the arrow. Then during the first third of revolution the slide *a* will move backward, slide *a'* will rest, while slide *a''* will move forward with a speed equal to that of *a*, thus causing the needle block to move along the right-hand side of the triangle. When it has reached the corner the cam will then be in position to move slide



a' forward, *a''* backward, while *a'* will rest. This will complete two-thirds of a revolution, and the block will have moved along the front to the left-hand lower corner. During the last third of revolution of the cam slides *a* and *a'* will be in motion, and *a''* will rest. The block will then have moved along the left-hand side of the triangle to the position it occupies in the drawing, thus completing the circuit. These movements are all uniform and positive. To prevent the slides from interfering in passing each other, they may be made something like what is shown in Figs. 9, 10 and 11. Fig. 9 is a section on line *A B*. The triangular frame may be secured to the pedestal in any desirable manner, while the cam is allowed to revolve freely between them."

Mr. Love's explanation and drawings are so clear that I think no one will fail to comprehend them. The so late arrival of such a good solution proves that these problems are interesting subjects of thought long after they have apparently been dismissed from consideration.

The Natural Governing of Direct-acting Steam Pumps—II.

BY DAVID GUELBAUM.

Suppose now a normal direct-acting steam pump satisfies the condition indicated in formula (1), all its parts inclosed between the two air vessels will then form together one solid moving body. The next question to be decided is, What will be the velocity of this body, or the mean working velocity of the piston, and by which law is this velocity governed? The analysis shows that the mean working velocity of a normal direct-acting steam pump is the greater the longer the piston stroke; the less the total weight of the moving parts; the greater the total forcing height, including also frictional resistance; the larger the steam expansion, and the higher the original steam pressure. The relation between the above quantities is determined by the following formulæ:

$$\frac{S}{L} = \frac{2}{g}\frac{V^2}{H} \times K \qquad (2)$$

Where S = the length of the piston stroke.

V = the mean working piston velocity.

H and L have the same meaning as given above.

g = acceleration due to gravity = 32.2 feet = 9.8 meter.

K = is a coefficient perfectly independent of any of the dimensions of the pump or steam cylinder, and determined exclusively—like an indicator diagram—by the mode of working of the steam, *i. e.*, it depends only of the original steam pressure, on the degree of steam expansion, and on the pressure on the exhaust side of the piston; K is decreasing with increase of the steam expansion, and with increase of the original steam pressure. Actually K represents a reciprocal of the mean value of the surplus of work done by the steam power over the work of the resistances at successive points of the stroke, referred to one unit of the volume of one piston stroke displacement. Therefore, in cases when the steam is worked at uniform pressure, this surplus can be kept as small as desired, and consequently K will have a high value; contrary, in case of large steam expansion the surplus of work of the steam power over the work of the resistances at the successive points of stroke will be comparatively very high, consequently K will be very small. The numerical value of K for any particular case can be computed pretty nearly by calculation from certain formulæ, or from an indicator diagram taken from the steam cylinder at the required working conditions. The formula for calculating the value of K is very complicated, and therefore will not be given here. This rather long explanation of the meaning of K was necessary for the correct understanding of formula (2), which enables us to determine the mean piston velocity for any given working conditions.

The above formulæ (1) and (2) will enable us to answer the questions set forth at beginning of the article. The two principal conditions necessary to make any direct-acting steam pump a practical working machine are, first, a safe movement, and second, an ascertained practicable mean working velocity. The above two formulæ are based on these conditions; moreover, all the component parts of the pumping plant, from the suction air chamber up to the discharge air chamber, as well as the mode of working the steam, are all represented in these formulæ, which contain all the possible dimensions of the water and steam cylinders, and their connections, so that the influence of each item of the plant upon the motion of the pump can be read from them, and enable us to answer the first of the three questions, namely, What are the real laws of motion of a direct-acting steam pump? These laws can now be ascertained, and the influence of every part and dimension of the water and steam cylinder with their connections, as well as the mode of working the steam, upon the safe movement and working velocity of the pump is known, and can now be predetermined.

The second question, namely: Are the difficulties met with in practice in the working of direct-acting steam pumps due to the nature of the required motion? must be answered negatively, because it is evident that the many different parts of a normal direct-acting pumping plant can always be so proportioned as to satisfy the two principal working conditions, as expressed in formulæ (1) and (2). Therefore, if trouble arises in the working of this machine, it is not because its nature does not admit a better motion, but because in the designing or erecting of the pumping plant the fundamental laws of motion of this machine were left out of view, and have not been complied with, under the supposition, of course, that the mechanical details of this machine have been worked out correctly.

The third of the three questions, namely: Is the present adopted complicated method of governing high-duty direct-acting steam pumps the only possible one? must be answered relatively to the required working conditions. By this I mean to say the following:

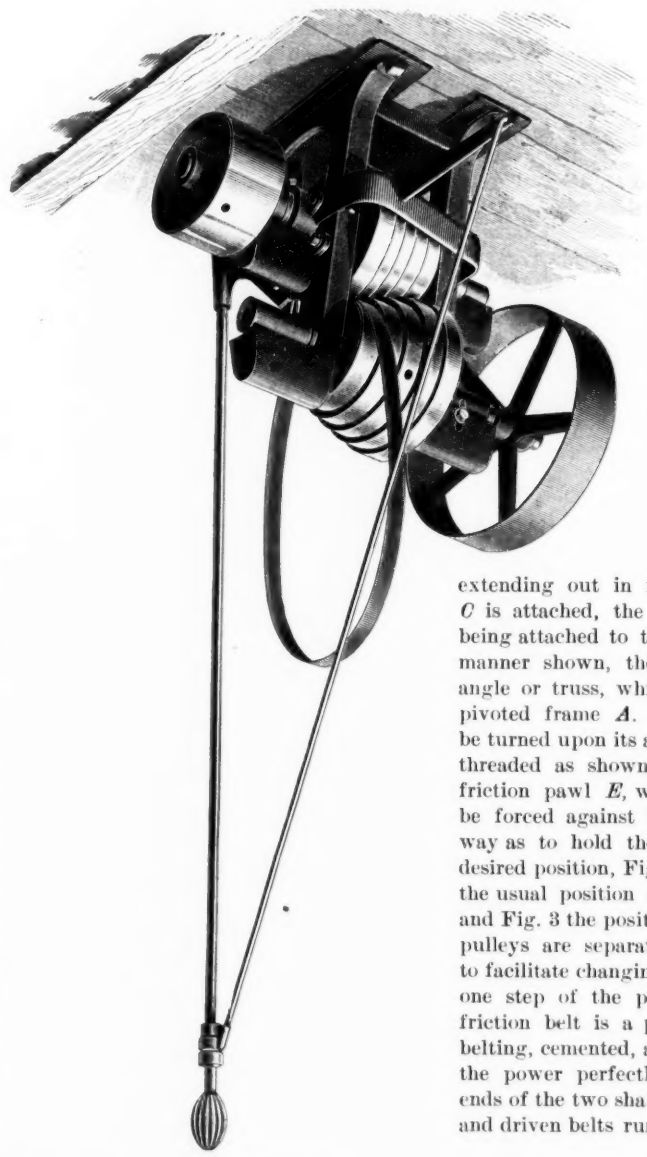
In a very high-duty pump, *i. e.*, in a pump worked with very high steam expansion, say 8–10 times of the original steam volume, the mean value of the surplus of the work performed by the steam at successive points during the piston stroke, over the work of the resistances during the same path, will be comparatively very great, and, therefore, coefficient K in formula (2) will be very small, as explained above. On account of this, according to the same formula (2), the value of the mean working velocity v would become very high; to lower it to its practical limit the total weight L of the moving parts would have to be increased as much as to reduce the velocity v to a reasonable value, as follows from formula (2). This can be attained by increasing the distance between the discharge air vessel and the pump, *i. e.*, by increasing the length of the water column l_0 connected closely to the pump piston. But in this case, in formula (1), which expresses the condition of safe movement, the ratio $\frac{L}{l_0}$ would decrease, its limit value being nearly = 1, and together with it the degree of safety would also be diminished. To compensate this, we may increase the ratio $\left(\frac{a_0}{A^1}\right)$, but the cross-section of the discharge pipe a_0 is not being made in practice larger than the pump piston area (A^1); therefore, the value of ratio $\left(\frac{a_0}{A^1}\right)$ is also limited, its maximum value being = 1. Therefore, to reduce the piston velocity without affecting the safe movement, in the case of a very high-duty pump, *i. e.*, to satisfy at once both formulæ (2) and (1), the only thing to be done is to decrease the value of p, that is, to relieve the steam piston of a part of the original steam pressure. This can be done only by a compensator, *i. e.*, by the introduction of some contracting body, because with large steam expansion the original steam pressure must necessarily be high, and cannot be directly reduced. Formula (2) shows also another way for satisfying both equations at once, besides relieving the pressure p on the steam piston, namely, by increasing directly the total weight L of the moving parts without increasing the length l_0 of the forcing water column connected with the pump piston, so that the value of the ratio $\frac{L}{l_0}$ would increase, and, therefore, also the safe movement would increase; of course, this likewise means the introduction of a compensator, only in the form of some moving weight. Thus formulæ (1) and (2) give full answer to the third question, *i. e.*, they indicate clearly the extreme circumstances when a direct-acting steam pump cannot be governed by natural means, and the introduction of some artificial compensator becomes necessary.

In the above discussions I had chiefly in view to point certain questions which probably have presented themselves to many other engineers, and to show the possibility and means for a clear scientific answer to these questions. But I believe it to be best to leave it to the intelligence of the engineer to investigate the above formulated laws of motion of direct-acting steam pumps and to determine the influence of the different parts of the plant upon the working of the pump for different cases in practice. I desire here to point out only one feature of the modern practice in the construction of direct-acting steam pumps. As mentioned in the introduction of this article, in existing direct-acting steam pumps of average dimensions—not high-duty pumps—steam of low pressure only is being used; the piston stroke is being made very short—less than the diameter of the steam cylinder and rarely exceeding 10 inches—and the mean working velocity of the piston is kept very slow—between 10 and 20 inches per second only, while in average steam engines the stroke is always greater than the diameter, and the average velocity amounts from 80 to 200 inches per second. The low-pressure steam used in direct-acting steam pumps may be accounted for as increasing the degree of safe movement, as indicated by formula (1), while the shortness

of stroke may be considered as a consequence of the desire to keep the piston velocity slow, because, according to formula (2), the piston velocity v increases with the increase of the length of the stroke s. The reason for keeping the velocity so small may lay in the desire to reduce the friction, to have a quiet passage of the water through the suction and discharge valves, and, in general, to secure a safe and steady working of the pump. With regard to friction there are three different kinds of it in pumps—friction of the water in the mains, friction at the passage of the water through the valves, and friction of the pistons in the steam and pump cylinders. Now, the friction in the mains has nothing to do with the speed of the piston. It depends solely on the size of the mains, which is usually being determined with regard to the prime cost of the plant, the expected revenue from the concern, and the working expenses as influenced by friction in the pipes. Likewise the friction through the valve passages depends on the size of the valve openings only, which are usually made to suit the size of the mains. The friction in the steam and pump cylinders may, indeed, be influenced to a certain amount by the speed; but taking in consideration that by decreasing the piston velocity the piston stroke must necessarily be made very short, and, consequently, the losses of steam caused by the clearances in the steam cylinder and by communication of the steam cylinder with the atmospheric air or condenser at each end of the stroke will also increase, it remains still a question whether any steam economy is really obtained by constructing direct-acting steam pumps with very slow working velocities.

Concerning the decreasing of the piston velocity for the general safe movement of the pump, I must say that the condition of safe working of a direct-acting steam pump with regard to the pumped water, that is to say, to secure a full water displacement of the piston stroke without slip and blow, is strictly determined by formula (1); that, as shown above, this degree of safety depends on many different quantities besides the piston velocity, and will be different for each particular case in practice. The safest way in each case would be to verify directly the ratios of the different dimensions of the whole pumping plant by means of formula (1), and if a sufficient degree of safety will be indicated by this formula, then I do not see any reason for reducing the piston velocity from a point of view of working safety.

The wearing out of the solid moving parts certainly depends directly on the piston velocity. But this should be no more a special feature of a direct-acting steam pump than of an ordinary steam engine or any other machine. The foregoing considerations relating to the reasonable mean working piston velocity for average direct-acting steam pumps, and the sizes of the pump for a required capacity, may still be interesting from another point of view. I am not aware of the existence in the market of a direct-acting steam pump of average dimensions provided with a cut-off mechanism—high-duty pumps with compensators excepted. To me it seems an easy task to cut off the steam in a simple way in a direct-acting steam pump of any construction, and certainly it is not for lack of a cut-off device that all direct-acting steam pumps of average dimensions are being constructed without it. The reason for this strange omission in the practical development of direct-acting steam pumps must be looked for in the real laws of their motion as expressed in the formulæ (1) and (2). If formula (2) is applied to any average direct-acting steam pump provided with air vessels and the mean working velocity v determined on the assumption of the existence of a cut-off cutting off steam at, say, $\frac{1}{8}$ or $\frac{1}{4}$ of the stroke, it will be found that the mean piston velocity would amount to 8 or 10 feet per second, while in the present practice the piston velocity is only about $1\frac{1}{2}$ feet per second. Here lies the reason for the existing practical impossibility to make a direct-acting steam pump work with a cheap arrangement for steam expansion, as in ordinary steam engines. But the same formula (2) shows that by increasing the total weight L of the moving parts the piston velocity v is decreasing. In case, therefore, of a long forcing main, L can be increased as much as desired by simply placing the discharge air chamber further from the pump, and thus retain the piston velocity v at its original value of, say, $1\frac{1}{2}$ feet per second. The necessary distance of the discharge air chamber from the pump, as determined from formula (2), would be, for this case, about 300–400 feet. If, instead of $1\frac{1}{2}$ feet, a velocity of, say, 3 feet would be allowed, then, as L decreases at the rate of the square of the velocity, the necessary distance between air chamber and pump would be 4 times less, *i. e.*, about 100 feet only. This consideration shows the importance of the admissible piston velocity in direct-acting steam pumps. But, even in the case of a forcing water column of 400 or 500 feet long, its motion can still be made as safe as that of a solid body, without danger of a water blow or slip, by simply complying with the condition of safety as expressed in formula (1). Therefore, in principle, the nature of the motion of a direct-acting steam pump admits its working in the same economical way as an ordinary steam engine with cut-off. A difficulty would arise in controlling the air chamber, which is placed out of reach of the attendant, without an arrangement for controlling it; but there is no difficulty in designing such a device. In conclusion it may be said that it is not difficulties like the foregoing that stood so long in the way of pump builders to place in the market a simple and economical pump, but rather the complicated nature of this machine, which was never duly investigated.



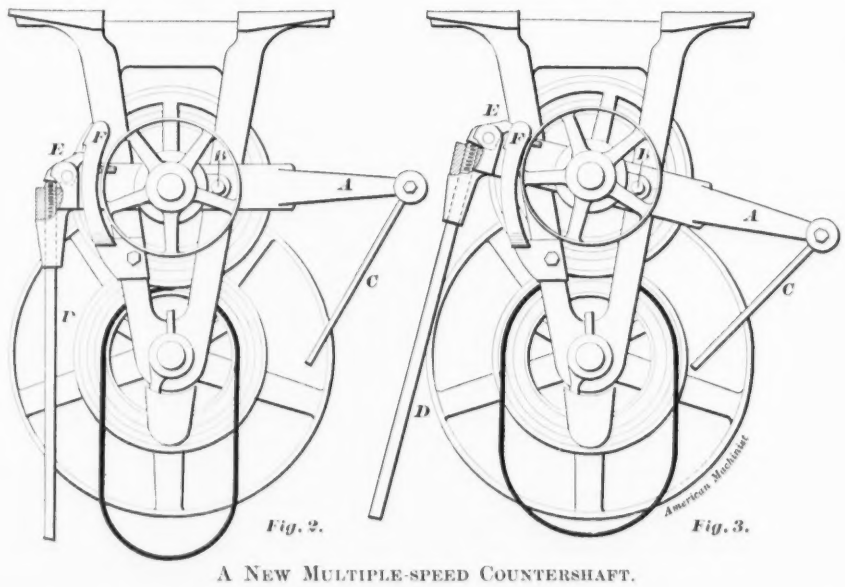


Fig. 2. Fig. 3.

A NEW MULTIPLE-SPEED COUNTERSHAFT.

A New Multiple-speed Countershaft.

With this we present illustrations of a new countershaft, which is designed especially for use in connection with grinding machinery, and to give the proper speed to any diameter of wheel which may be used.

It will be noticed that there are two shafts supported by the hangers, the lower one of these being supported in fixed boxes in the usual way. The upper shaft, however, is supported in boxes which are fixed in the hinged frame A, which is pivoted at B, and has an arm extending out in front, to which the rod C is attached, the lower end of this rod being attached to the shipper rod D in the manner shown, the whole forming a triangle or truss, which gives control of the pivoted frame A. The shipper rod D can be turned upon its axis, and its upper end is threaded as shown, and bears against the friction pawl E, which by this means can be forced against the fixed arc F in such a way as to hold the pivoted frame in any desired position, Fig. 2 showing it in about the usual position occupied when working, and Fig. 3 the position when the two cone pulleys are separated as much as possible, to facilitate changing the friction belt from one step of the pulley to another. This friction belt is a piece of ordinary leather belting, cemented, and is found to transmit the power perfectly. The pulleys at the ends of the two shafts on which the driving and driven belts run, may, of course, be of any desired size or proportion to each other. Something over a year's trial of this shaft in the shops of its makers, the Norton Emery Wheel Co., of Worcester, Mass., has shown it to be entirely practicable and well suited to the purpose for which it was designed.

Those of our readers who have followed our descriptions of the various heavy tools and appliances put into the Washington gun shop know that this establishment is equipped for making guns up to 16″ bore, but so far the heaviest gun made has been 13″. The construction of a 16″ gun was strongly recommended by Com. Folger, who believes that the sources of trouble which have been encountered in England with guns of this size can be avoided. Such a gun would be 511½″ long; 64″ greatest outside diameter; would weigh 246,400 pounds, and would throw a projectile weighing one ton to a distance of 16 miles, using 1,000 pounds of brown prismatic powder. At a distance of 1,500 yards this projectile would be expected to penetrate steel armor 16″ thick. It is estimated that the gun would cost $120,000, each projectile $800, and the powder for a charge $300.

Traveling Cranes and Runways—World's Columbian Exposition.

Now that the buildings are completed, the question of rapid and convenient installation of exhibits is the one great problem at the fair. In all the larger buildings, excepting Machinery Hall, installation tracks will run through one or more of the main alleys of the building; thus the exhibits can be taken quite near to their proper section. In Machinery Hall the installation tracks will only enter the extreme west end of the annex, where they will run under three large traveling cranes, which travel the entire length of the building. By these cranes most all of the exhibits can be located exactly—without the touch of crowbar or roller.

A contract was made with the four following companies, associated as one party for this particular contract: Edgemoor Bridge Works, Wilmington, Del.; Yale & Towne Co., Stamford, Conn.; Wm. Sellers & Co., Philadelphia, and Morgan Engineering Co., Alliance, Ohio, by which the first company was to furnish the runways, and each of the last three a crane.

These cranes are of twenty tons capacity, each having two trolleys of ten tons capacity each. They are of 75 feet span, and their runways are each about 1,300 feet, or nearly a quarter of a mile long. They are operated entirely by electric motors, electricity being had from trolley wires supported along the runways.

The runways have been in place for some months. They are built of iron plate girders of about 25-feet span, supported upon steel A-shaped posts. Over the power plant the girders are of 50-feet span, are supported upon steel columns of small rectangular section, and are braced horizontally from the main roof arches of the building. Each runway is located, centrally, down one of the three rows of arches in Machinery Hall, and extends in the same lines to the installation tracks in the annex. They are capped by 60-pound steel rails, the tops of which are 21 feet 3 inches above the floor.

The posts have been planned to support the line shafting at a height of 15 feet above the floor, and the 25-foot girders each two hangers, approximately one-third of their span apart.

This shafting will supply power to exhibitors in all parts of the Machinery Hall and annex.

The runways are calculated for a load of 86,000 pounds at each end of crane, and a horizontal pull of 2,000 pounds at shafting box of each hanger, with a maximum fiber stress of 20,000 pounds.

The Morgan, and Yale & Towne cranes are in place, and the Sellers is well under way.

After the first of May, when installation work is completed, these cranes will be used for a rather unusual class of work. They will be floored over and furnished with seats, railings and gates, and used for carrying passengers at the break-neck speed of 300 feet a minute—fully 200 feet slower than may be used in installation work. From these platforms, which will be fully 30 feet above the floor, an excellent view can be had of the entire exhibit, and a partial idea gained of the field covered in the great realm of machinery.

Jackson Park, Jan. 19, 1893.

Tools for Brass Work.

BY FRED H. COLVIN.

The tools to be described in this paper are what are commonly known as "necking" tools, but before going further with this subject it will be best to still further specify their use. To those unaccustomed to the different operations in the brass shop, it might seem as though any tool designated as a "brass tool" ought to be suitable for any kind of brass work on the same machine; but in reality there is as sharp a line drawn between tools for large turret work and small turret work, as between iron and brass. In the small turret, where the speed is high, it is possible to use tools with so little guidance that in a large slow speed turret these same tools would be useless. At high speed it is possible to use mills on long spindles (*i. e.*, the work may be long, slender spindles) which, if attempted on slow speed on heavy work, or even on the same work, would throw the work out of true if not out of the chuck. So in describing tools for turret work it is necessary to distinguish between the work and the speeds.

At high speeds it seems as though the work had no time to jump out of place before it was around again to be knocked in place by another part of the cutter, but in slow speed this is not the case. Now to our necking tools.

When we wish to screw a cover (as in an oil or grease cup shown at *a* in Fig. 1) down snug to the body of the cup, it is necessary to undercut the thread of the cap, or else cut out a thread or two in the body; the former is the better practice and is usually done.

On small work at high speed this is a simple task, for all that is necessary is a small tool similar in shape to the point of the Fox lathe back head tool, and so arranged as to be readily thrown in and out by a small lever or otherwise.

Then, after milling the cap for the thread, the necking tool cuts out the recess or neck, and the die finishes the job, having a place to break through without striking the back of the cap. For this kind of work no guide for the work is necessary; the tool just digs in, the chips fly and that is all, but when we try this on heavy slow speed work the result is different. The tool digs in—just the same as before—but the chips don't fly and that isn't all, for the work hangs on the tool, and instead of the chips flying the work is jammed out of the chuck and plays havoc generally. It was to avoid this that the tools to be described were designed, and their design is a growth of several months—not of steady work, however, but the designs of different parties made from time to time, and from which the tools now in use were selected. That the work must be guided was a foregone conclusion, and with that end in view, and with but two available ways of doing this (either by interior or exterior guides), the designs were made.

We have not fully decided as yet upon which guide we shall ultimately use, though at present we are using the exterior guide, or, more properly, the guide is interior, but guides the exterior of the work.

The holders of all the tools are made to fit the turret direct, and can be classed as "wing" tools, and in this wing lies all the mechanism, if it can be so called, which performs the work. The first design, shown in Fig. 2, was simply the regular wing tool with a planed slot, as shown in the end view of the wing *A*, the cutter being shown in section, the clip *D* in place held by the cap screw, and the threaded hole *T* for the screw which moves the cutter in and out.

The top view of the tool does not show the clip in place, but shows the cutter *C* and the screw *T* in place and the handle for operating it, the handle being of the flat type, for economy of space.

The clamp *X* simply holds the cutter, and is moved by the screw as shown, moving the cutter simultaneously. Instead of a separate stop, the cutter is adjusted in the clamp so as to bottom the clamp on the end of the wing when the cutter has cut deep enough.

Fig. 1

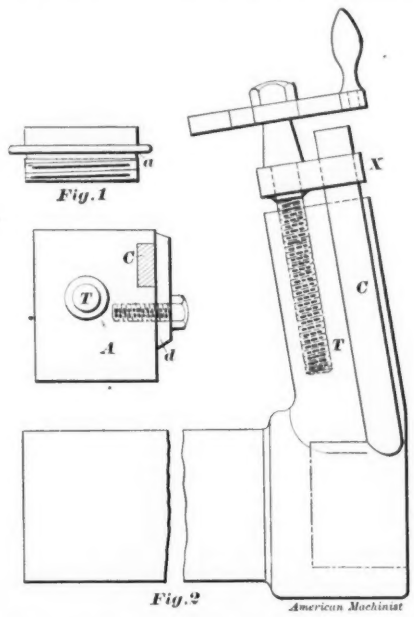


Fig. 2

This is a simple design, the slot being planed to a commercial size so as to make the cutters at the least expense, and the whole cost of construction is not great.

As I have before mentioned, it is always desirable to design so as to use commercial sizes of steel, or any other commodity that you can buy in the open market.

While this is simple it did not end the subject, and the next device considered was similar and yet somewhat different.

This consisted in using round drill rod steel in place of the square or flat steel before shown. For small tool rooms, where the planer and milling machine are minus quantities, this is quite an item, and it has some good points besides these.

It can be turned in any direction so as to get the desired rake for the cutting edge without removing and grinding for that purpose, besides being, generally speaking, cheaper to drill the hole than to plane the slot in the previous device.

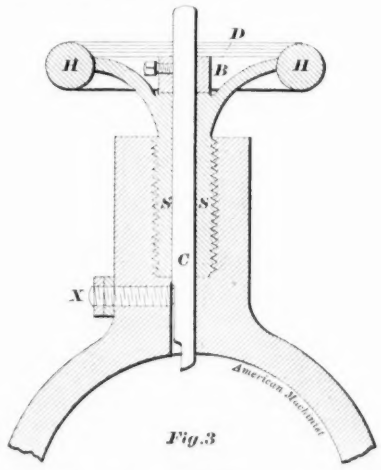


Fig. 3

There was one drawback to this device, however, which might not have been enough to interfere with its workings, or which might very seriously interfered with them, namely, in case the holes for the cutter and for the screw were not drilled parallel.

The distance to be traveled was short, it is true, but it doesn't take much to bind a screw and rod when both are good fits, as these should be.

Where we have a vise to hold the work in while drilling, or have some good means of clamping it under a good drill press, this objection would not, perhaps, be valid, but where the work must be held by hand and drilled in the lathe it becomes another matter altogether. These are some of the things that the small shop tool maker has to contend with, and he must avoid them wherever possible.

The third design avoided this in a very ingenious manner, and a section view is shown in Fig. 3. The screw *S S* is made with the wheel handle *H H* attached, and notwithstanding our friend Harrison's very good article on "The Hand-wheel Lunacy," the hand-wheel seemed the best adapted for this particular place—at any rate the designer thought so—though, perhaps, a crank handle might have been used.

But as this never got beyond the design, the question remains unsettled.

The cutter *C* is of drill rod steel, as before, and to it is fastened the collar *B* by a set-screw as shown. The plate *D* fits over the wheel and holds the collar *B* between the top of the screw and itself, making the cutter move with the screw. The set-screw *X*, which is flat-pointed and held by a nut and check nut, bears on the flattened side of the cutter and so prevents it from turning, thus giving the cutter motion with the screw, but not allowing it to turn with it. The flat for guidance can be ground as deep as desired, and the cutting edge should be ground about half way down, as shown at the end of the cutter. This had the disadvantage of requiring the operator to grasp the edge of the wheel only on one side, so as to avoid interfering with the rod which projects through. While not really necessary for it to project through to any great extent, it seems best to allow a little for grinding away, thus lengthening the life of the tool, and when drill rods cost as they do at present it is an object to save them as much as possible.

In the tools so far shown the only means of motion has been by the screw, but as this is hardly desirable for the operator it was decided to use the lever in its place.

Of course this lever or cam can be so modified as to get any desired motion, and is much to be preferred, because a single motion will take the place of the turning of the screw, as has been shown.

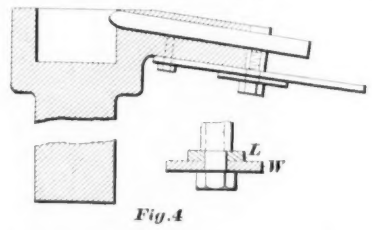


Fig. 4

With this in view the lever was adapted to nearly all the previous designs in some form or other, with the result of improving the means of operating by making less movements for operator, but none of the designs were quite satisfactory.

The outgrowth of all these is shown in Figs. 4, 5 and 6, which present a design easily made, easily operated, and of cheap construction.

It retains the drill rod for the cutter and uses the lever movement, which combination seems very well adapted for the work in hand.

As will be seen, the hole is drilled in the same place as before, thus forming the guide for the cutter, as in previous designs: the clamp or block holds the cutter from turning, and, as before, imparts motion to it from the lever.

In the back of the clamp, as shown in the small cut (Fig. 4), is a special cap screw with a plain bearing from the thread in the block to the head; the lever section is shown at *L* and the washer *W* holds the lever against the block and forms a guide for the back of the lever. Figs. 5 and 6 will show the position of the lever and the angle of the inclined slot. By hanging the lever as shown there is a tendency to draw out of the work by its own weight, thus preventing an accidental cut by pushing the tool over the work with the cutter thrown down.

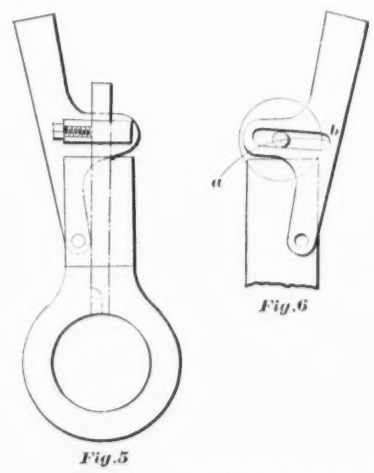


Fig. 6

Fig. 5

In this the cutter is adjusted as before, so as to bring the stop against the end of the wing or the bottom of the inclined slot when the cutter has been thrown down to its proper depth. The arc *a b* in Fig. 6 will show the travel of the block up and down, and give a better idea of how the right angle for any throw is obtained. By hanging the lever as indicated it is possible to get a much gentler incline to force against or with than by hanging it on the other side of the center. In fact, it is a very interesting study to lay out the angle and travel from the different centers of suspension, and gives one a good idea on the subject which comes handy in other matters.

Marine engineering on the Clyde during the past year has been fairly busy. The total indicated horse-power of the engines constructed was 289,564, compared with 308,886 the preceding year. The number of sets is not stated in every instance, but the total given is made up of 70 sets of compound, 89 of triple-expansion, 8 of quadruple-expansion, 4 of paddle engines, and 2 of land engines.—*The Steamship.*

LETTERS FROM PRACTICAL MEN.

Sensitiveness of Touch—Close Measurements.

Editor American Machinist:

Having some friends engaged in the hardened steel ball business, and being more or less interested in machine shop measurements, I was naturally interested in your account of Ambrose Webster's thumb and finger caliper, and could only reconcile your statement to my conception of the possibilities by fancying you had one too many ciphers on the account. It takes a fairly good man to detect the one ten-thousandth of an inch difference in the size of a piece with common calipers, and to concede that a man could do better with his fingers was, at first, straining to one's belief.

Picking up some sample balls at hand, it took but a moment's fingering to note that they were not round, and one appeared to have the same peculiarity noted in your account. While we had no means at hand for determining the absolute variation, it was easy with the small measuring machine to determine that the variation was not far from one ten-thousandth of an inch.

The figures .0001", I believe, make no very clear impression on the minds of many of your readers, except to convey the idea of a small amount, nor is the fact, when stated as the *one ten-thousandth of an inch*, much more definite.

Perhaps a better conception will be given by comparison. The AMERICAN MACHINIST is printed on paper about three and one-half one-thousandths (or thirty-five ten-thousandths) of an inch thick, hence the one ten-thousandth is practically one thirty-fifth part of the thickness of the paper the reader holds in his hand. Tissue paper is usually about one one-thousandth thick. Human hair will average about two and one-quarter one-thousandths. The finest hair I ever measured out of thousands was one and one-half thousandths (that is, fifteen ten-thousandths), and this was the only one under two one-thousandths, and it may be well to know that every hair in a person's head is practically alike. So it will be seen that Ambrose Webster can, with his fingers, determine a variation in a ball which is out of round to an extent equal only to the one-twentieth part of the thickness of the finest human hair.

It is no uncommon thing to meet machinists who marvel where a thousandth of an inch is mentioned, while the same men measure to one-quarter of that size with the greatest ease, and to such a machinist a little experimenting with a piece of tissue paper is excellent practice. As an example, take two parallel strips of any kind (two scales will do), lay them together with a strip of tissue paper between, and set the calipers over the two, then remove the tissue paper and try the caliper again. One trying this will no longer question his ability to caliper to the quarter of a thousandth. Some of

these experiments are interesting, instructive, and at times valuable.

A machinist—if he has no measuring machine of any kind—can, with these few facts, get at small measurements pretty accurately. Supposing he be told to make a forced fit of a four-inch shaft, and that he needs to allow about eight one-thousandths. With two thicknesses of the AMERICAN MACHINIST and a thickness of tissue paper he is likely to get a good deal nearer than he can guess. Two thicknesses of any daily paper and two thicknesses of tissue paper will also be pretty nearly right.

JOHN E. SWEET.

Cam Rollers.

Editor American Machinist:

Mr. W. F. Durfee is quite in error as to the origin of the article on cam motions in my book, "Modern Machine Shop Practice."

Anybody reading his letter in your issue of December 29th would be led to believe that the matter on pages 80, 81, 82, 83, 84 of my book was an appropriation of another's work without due acknowledgment—a charge that I cannot allow to pass unnoticed.

First let me inform Mr. Durfee that I began to write "Modern Machine Shop Practice" in 1873, and gear wheels, screw threads, cams, etc., were the first part of the work that was written.

Many of the articles appearing in the mechanical journals between the years 1873 and 1886 were taken from the manuscript of "Modern Machine Shop Practice," some having been written years before they appeared in print. Indeed, my last year on "Modern Machine Shop Practice" was principally occupied in going over the earlier manuscript and bringing it up to date.

Now as to the part of my book that treats of cam motions and its origin. About the year 1877 Professor Coleman Sellers (to whom I am indebted for many valuable hints) called my attention to the fact that the instructions given in various books, etc., for drawing a heart cam were wrong, inasmuch as they did not take the diameter of the shaft into account. This I made a note of, and shortly after, in looking over the MSS. of "Modern Machine Shop Practice," found that I had made the same omission, and at once corrected it, making a new drawing, now Fig. 225, page 80, of "Modern Machine Shop Practice."

In 1883 I met at the office of *Mechanics* Mr. Arnold, who was then writing some very interesting articles for that journal, and in the course of conversation the cam question came up, and he said, "Jordan is the man to talk to on the cam question; why don't you go over to Bliss' in Brooklyn and see him?" In the course of a week or so I went, and he kindly gave me much valuable information, and I found he had the whole thing at his fingers' ends. On returning home I made some zinc templates, worked out the problems contained in Figs. from 226 to 244 of "Modern Machine Shop Practice," made the drawings, wrote the descriptions, and pasted the whole in the manuscript of "Machine Shop Practice." Then, as Mr. Jordan was busy at the time, I prepared for *Mechanics* the article referred to by Mr. Durfee, which embodied the views of Mr. Jordan, who was therefore entitled to the credit I gave him. Meantime I had met at H. S. Manning's office Mr. Brady, of Brooklyn, and knowing that he had patented a cam motion, and having found that whatever he did was worth looking after, I got him to make me on the spot a sketch of his cam, and this sketch is the parent of Fig. 245, page 84, of "Modern Machine Shop Practice."

Mr. Durfee will doubtless now see that he jumped to a conclusion that was erroneous, and that there was no plagiarism, either of the rankest or of any other kind. I have suffered too much from having my articles and writings taken bodily, or else hashed and rehashed, not to feel quite alive to the wrong of such actions, and I venture to say that I believe that no other work of the size and scope of "Modern Machine Shop Practice" contains anything like the same amount or proportion of original matter and research.

Passing now to the discussion of the cam question, I should say that Brady's cam is superior to either the conical roller cam applied by Mr. Durfee, or the parallel roller preferred by Mr. Gribben, because it has the advantage of not grinding itself out, which both Mr. Durfee's and Mr. Gribben's cam do, while it can be constructed on the principles advocated by either Mr. Gribben or by Mr. Durfee.

JOSHUA ROSE.

Normanton, Forest Hill, London.

Conical Cam Rollers.

Editor American Machinist:

A conical cam roller is theoretically right when it operates a slide which travels in straight guides parallel to the center of the shaft upon which the cam is mounted. It is not theoretically right anywhere else. It is not practically right anywhere, because it does not, as a matter of fact, wear as well as the cylindrical roller; because it is more expensively fitted, and because it encroaches at its small end on the stud, and makes rotation difficult.

The conical roller was tried on a sewing machine made many years ago in Bridgeport, Conn., I think, and it was replaced by the cylindrical roller. It was tried about six years ago at Elizabethport, N. J., and it did not work, because it was too troublesome to fit, and it would stick and wear flat. Some thousands were tried; I have tried them and have invariably found them bad unless the proportion of the stud to roller is very small in diameter. I have had to do with the fitting of many millions of cylindrical rollers with invariably good results.

A large roller cannot always nor generally be had; neither can a large cam. Consequently to get strength and short curves the cam roller must be as little larger than the stud as practicable. Hence a conical roller on a cylindrical stud is no good, and no one has suggested a conical stud. Does any one know of a commercially manufactured machine with a conical cam roller on it? There is nothing new in a conical roller, neither is there anything practical in it.

A. D. PENTZ.

Cam Rollers.

Editor American Machinist:

Comparing the remarks of Mr. Hardinge, in your Jan. 5 issue, with those of Mr. Pryibil, under the same date, it looks to me as though the latter might, perhaps, explain the former. Is Mr. H. perfectly satisfied that the cam rollers he mentions had sufficiently large bearing surfaces on their studs in proportion to the pressure brought to bear on them, to prevent the oil from being squeezed out? I fail to see how the theoretically incorrect shape of the outside of roller could cause it to stick on the stud when well oiled.

WALTER GRIBBEN.

Section Paper and Its Correct Use.

Editor American Machinist:

For ordinary drafting room use, and the plotting out of work, there is nothing that accelerates drawing so much as the use of section paper. It was first adopted for general use in the drafting room of the Brown & Sharpe Manufacturing Company, Providence, R. I., in 1886, where it is used to great advantage for all detail work. Twenty or more firms have since learned to appreciate its value, as none can fail to do who use it a few times.

Just as the thin unshaded lines for drawings gave way to the heavy-shaded ones, so will the old method of first making a pencil drawing upon cheap paper, and then tracing in ink upon cloth for blue-printing, have to succumb to the newer and quicker way of finishing the drawing entirely upon section-ruled paper and printing from it direct.

T-square and scale are dispensed with, as all lengths and center distances are readily found, and no inaccuracies are caused by long projections. The ruled lines act both for projection and construction lines, and no shrinkage or expansion of the paper destroys the accuracy of the reading, as it is read by the lines, and not from a scale.

The fact of the sheet being loose upon the board is also a great advantage, as it may be turned to any angle to suit the arm.

Section lines, when ruled in eighths, the half-inch lines made slightly heavier than the eighths, and the inch lines still bolder quickly catch the eye of the draftsman, and after a little practice it is easy for him to lay off readily any distances he desires, reading easily to thirty-seconds.

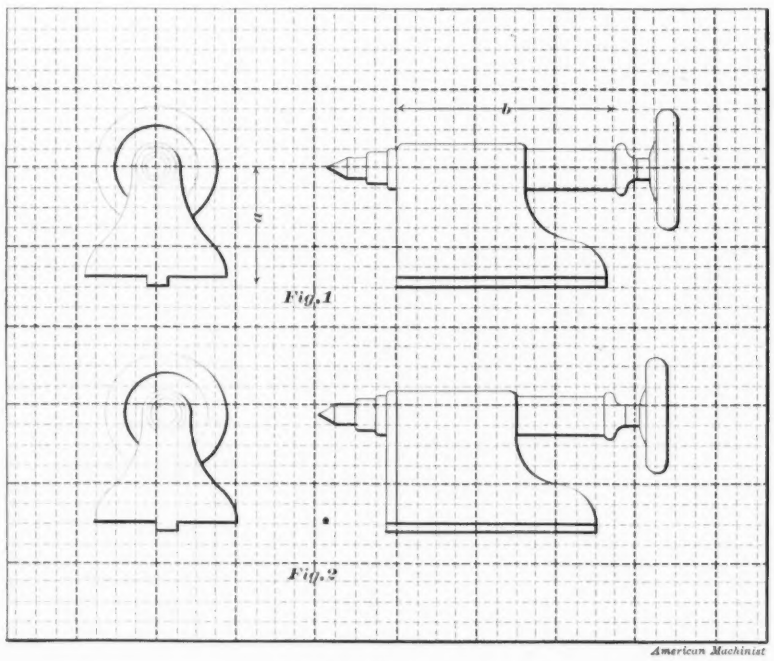


Fig. 3

SECTION PAPER AND ITS USE.

No. 25 unglazed bond paper, made by Crane & Co., Dalton, Mass., gives excellent results in blue-printing. By making the drawing in heavy lines upon the paper, and exposing from fifteen to twenty-five minutes longer, as good results are obtained as in printing from tracing cloth.

When figuring a drawing from which a blue-print is to be made, it is by no means advisable to use a pen, as the lines vary so in thickness, thin parts often printing out. Figures of even thickness and sufficient density can best be made with a hard boxwood Chinese writing stick, which is made in the form shown in Fig. 3.

Paper ruled in pink is easier for the eyes than that ruled in blue, but the blue is less likely to show upon the prints.*

To obtain well-spaced section paper the lines should be lithographed, not ruled.

Obviously it is much easier for the pattern maker to make patterns from a drawing made on section paper than where he would have to scale all the unfinished parts.

The full value of this paper, however, will not be appreciated unless the drawing is properly placed relatively to the heavy inch lines, as is demonstrated in the sketch.

In Fig. 1 the side and end elevation of lathe foot stock are so placed that the heavy inch section lines act as center lines, and, as far as possible, projection lines for the drawing.

In Fig. 2 the piece is shown drawn without regard to the heavy section lines, and it will be seen at a glance how much more readily such distances as *a*, *b*, etc., can be read from Fig. 1 than from Fig. 2.

The writer has found it convenient, when designing a piece relative to a part already drawn on section paper, to so place that piece that it shall bear the same relation to the section lines as it would do if drawn in position on the part.

H. M. NORRIS.

* Mr. Norris' paper is ruled in blue lines, which being unable to reproduce, we show as dotted lines. —ED.

The Danforth Case—Engineers in the Navy.

Editor American Machinist:

I have read your editorials on the Danforth case and Engineers in the Navy with considerable interest, and think you are doing a good work in agitating the general question. Naturally, I do not agree with "Veteran Naval Engineer," and I know from personal experience that much of the line and staff difficulty arises from the disposition of some of the aforesaid veterans.

I must confess that I do not altogether agree with you in your view that the education given at Annapolis between 1873 and 1882 does not fit the engineer graduates for marine engineers better than it does for other branches of mechanical engineering. I agree with you entirely that a marine engineer, or one of any other kind, cannot be made in a school, but the training at Annapolis in my time was anything but too theoretical. We had shop work, and from what I know of shop experience later, it was good shop work, and not the play kind that is to be found in some of the manual training schools of to-day; and we overhauled the engines there until they would apparently rather go to pieces than stay together, and we went out on Saturdays on short practice trips, in which we served in all capacities, from coal heaver to engineer in charge, and we took two practice cruises of three months each, in which we did the same sort of duty. Following that, we went to sea for two or three years before being examined for promotion, during which time we had engineer duties, and always did our own running, for we did not have "machinists" in those days. The cadets were considered as finally graduated only after this two years' post graduate sea service, and if all that does not constitute a better training for marine engineers than can be gotten anywhere else, I am very much mistaken. Certainly I am personally not prepared to receive instruction from the average marine engineer in caring for marine machinery, cleaning fires, doctoring balky pumps, patching boilers, making steam joints, packing rods, or any other of the multitude of things which fall to the lot of the unhappy marine engineer.

My own opinion as to why so many young engineers have left the service is that a man of reasonable intelligence can make a better living on shore, and have more comfort in his home in one year than the sea-going engineer gets in five. Doubtless the reasons outside the above, which have led to ex-navy men drifting into various lines, are largely questions of circumstances and individual preferences. It does not seem to me that it requires much more to turn a man from the naval service into shore life than it does to move engineers from one branch of the profession to another, as we know many of our acquaintances have moved.

I never knew of a case like Danforth's, and personally never had any difficulty on the line and staff question; in fact, some of the best friends I have in the service to-day are line officers. At the same time, if I had ever been placed in the position in which Danforth was—well, I suppose it is just as well that I got free from military discipline while I could do so creditably, as I would probably have been suspended or something worse.

"EX-NAVY."

Conical Cam Rollers—American and British Workmen and Machinery.

Editor American Machinist:

That Mr. Durfee's remarks anent conical cam rollers, published in your issue for November 10, are of interest, is evidenced by the number of comments they have called forth. It may be noted that somewhat similar conditions obtain in many of the simpler forms of steam engine governors, wherein the vertical movement of the balls is communicated to the throttle valve by means of a sliding sleeve, embraced by a forked lever carrying a pair of friction rollers, which engage with a groove in the sleeve. These rollers are nearly always cylindrical in form, but are usually slightly crowned, to obviate wear due to the differential speeds of the surfaces in contact. It is very rarely that conical rollers are used for this purpose, but I recently came across an engine, the governor of which was so fitted, and which was exhibited at the London Exhibition of 1862. I noticed a considerable amount of lost motion in the connection, and this appeared to be due principally to wear of the shoulder of the pin, which received the end thrust due to the wedge action mentioned by Mr. W. Gribben (December 8 issue). The conical roller, however, appears to me to possess a great advantage over the cylindrical form, inasmuch as in the former arrangements may readily be made for taking up the effects of end-long wear, say by employing screwed bearing pins and locking nuts.

Mr. Arthur's article on "American and British Workmen," published in your November 24 issue, is, I think, calculated to place the former on the best of terms with themselves, but it is somewhat regretable that this end could not have been accomplished without so much direct disparagement of British engineering methods and workmen. It is a safe rule never to underrate the capabilities of your competitors, and for this, if for no other reason, Professor Sweet's onslaught a few months ago is calculated to do more for American advancement than a score of Mr. Arthur's effusions. At the same time, Mr. Arthur deserves the thanks of the Britisher; for, although the picture he has presented is in many respects overdrawn and distorted, there can be no disputing the fact that many of Mr. Arthur's strictures are well merited.

With regard to locomotive construction, it is, of course useless to attempt to refute Mr. Arthur's claim that in American locomotive works more special machinery is employed than in this country. This is broadly true of almost every branch of engineering, and is due, as Mr. Arthur says, in the first place to the greater value of labor in America. It would appear, however, that the advantage to be derived by using special machinery more than offsets the difference in the cost of labor, and the wonder is that the average British engineer is so slow to recognize this fact. Mr. Arthur hits home especially in his remarks concerning the comparatively small use made of the milling machine in the locomotive shops of this country, although, had he visited one of the most recently erected shops over here, he would probably have seen enough to cause him to modify his ideas on this point somewhat. At the same time, I must admit that among British engineers generally the milling machine does not make the headway that—making due allowance for native conservatism—might reasonably have been expected. Only a few days ago, while in conversation with one of our large stationary engine builders, I inquired the reason why he did not make more use of the milling machine. He replied that he had tried them, but had found that for their work "the shaping and slotting machines were more suitable."

Mr. Arthur's remarks upon the design of the British locomotive are considerably more amusing than instructive. He apparently misses the bogie, and—without admitting it—he is puzzled to find that we manage to get along without it. He appears to forget that some twenty years ago the bogie was almost as extensively used here as in America; but with the greatly improved tracks now usually met with in this country, the bogie has, generally speaking, been found a luxury which it is possible to dispense with.

Mr. Arthur is again on the spot in criticising the clumsiness which frequently characterizes British methods in the smithy, the foundry and the machine shop. In the details of steam engines, machine tools, etc., there is frequently to be found such a superabundance of metal as to almost suggest that the work is sold by weight.

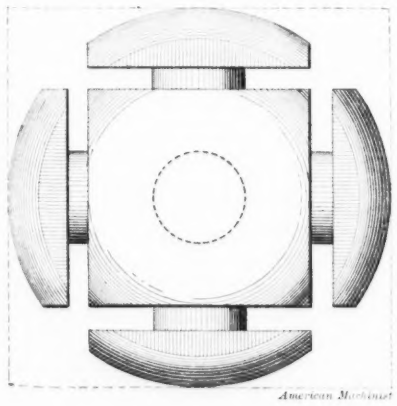
There is, however, just one point I would like to put to Mr. Arthur. He remarks that in America "machinery and methods are brought to such a high point that any handy man can be quickly taught." Further, he remarks that if an American machine shop "was put under boycott by skilled labor, men would be taken from laboring work and taught so soon that little serious delay would be suffered." Now does it not appear something of an anomaly that such a highly skilled, keenly sensitive and esthetic individual as Mr. Arthur's American workman should be employed in doing work which "any handy man" or laborer can be quickly taught to do? M. E.

Manchester.

A Wood-turning Exercise.

Editor American Machinist:

I have been a reader of your valuable paper for a long time, and have received much valuable information from the same. I enjoy the items from your different correspondents, and feel like sending in one for your consideration. It is a problem and exercise for manual training schools for the wood-turning department. Take a 2-inch cube of close-grained wood and turn a round ball, then take the ball and turn a cube having six square sharp corners, making a ball and cube combined, as shown in the drawing. This is done in a common wood-turning lathe with spur and female centers, and in turning the ball it is changed on different centers to make it more perfect. Next cut six ¼-inch grooves as shown, and it will be ball and cube combined. After it is turned fill up the centers and spur holes and you have a nice specimen, if made of choice wood. There are quite a number of graduates of different technical schools in this



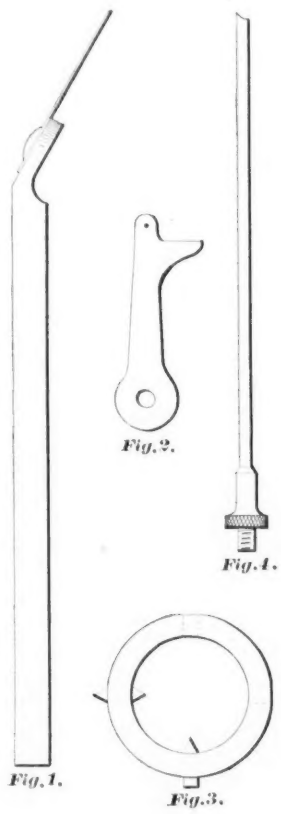
city, and none of them ever heard or saw this before I showed them the one I turned a few weeks ago. This might be a good example for the New York trade schools.

Moline, Ill. CHAS. W. HEALD.

Center Indicator.

Editor American Machinist:

The lathe center indicator shown by "Mechanic" in your issue of Dec. 18, 1890, struck me as being pretty good, and I accordingly made one. Since then, however, I have made another of the ring form, which "Mechanic" seems to think inferior. I find it works all right if the spring is made as shown in Fig. 2 herewith, the offset to spring always keeping ring in the same plane. The center punch mark in outer end of spring should be distant from offset half the thickness of ring. One advantage of the ring business is that it will admit of the clamps being placed closer to center of work than would be the case with the form in which "Mechanic" shows it, and this is often an important item on small work. It can be used also for testing the truth of male centers. In the one I made originally the small pin was removable, and I had an extra pin with a hole in one end; but this was a first-rate thing to get lost. In the ring they are driven in to stay, and either one is always available without the use of a screw-driver. The ring of my indicator (Fig. 3) is quartered, two of the holes having hardened pins driven in tight, while the holes opposite the pins are tapped to receive the pointer shown in Fig. 4. One of the pins is pointed on each end, while the other is pointed on its inner end and has a conical hole in its outer end. This latter is the one used to test a male center. The pins in my indicator are about $\frac{4}{10}$″ in length, which, with an 18″ pointer, multiplies nearly 50 times. It is all made of steel, including the pointer, as I was unable to obtain aluminum tube in small quantity. If using it on a soft metal, where there was much danger of wearing the center, it might help matters a little if the weight were relieved somewhat by a rubber band or spiral spring from tool-post wrench to common center of gravity of ring and pointer.



WALTER GRIBBEN.

Milling Cutters and Machines in England.

Editor American Machinist:

We notice in your esteemed journal of December 15th a letter from the Cleveland Twist Drill Co. giving the dimensions of a large milling cutter made by them, as follows: 21″ long and 5′ diameter, weighing 150 pounds in the rough.

It may interest your readers to know, in connection with the subject of large milling cutters, that we have frequently to deal with much larger cutters than the above. At the present time we have going through the works four cutters 11¼″ long and 10″ diameter, each weighing 270 pounds in the rough. Also two cutters 20¼″ long and 9″ diameter, each weighing 390 pounds in the rough.

Referring to the subject of milling systems in English workshop practice, the letter recently appearing in your columns from Mr. Arthur must have caused considerable surprise to many of your readers here. We may therefore be excused for stating, as a matter of interest to your American readers, that in the works of one of the railway companies here there are six of our large vertical milling machines employed in finishing the parts of locomotives, besides a number of milling machines of other designs of our make. In the same works there are probably an equal number of milling machines of the same styles by other makers.

We hope to shortly publish the engravings of a milling machine of exceptional size, now being supplied by us for dealing in a rapid manner with the parts of locomotives. The cutters mentioned above are for use on one of these machines.

SMITH & COVENTRY, Ltd.

Manchester, Eng.

At this writing there is considerable evidence going to show that the great coal combine by which the people have been mulcted of thousands of dollars is likely to be broken up. It seems to be to the credit of the State of New Jersey that this has been brought about. It may be true that this wicked, and, we believe, unlawful combine has come to grief will satisfy the minds of a great many people in this country; whether or not it may be true that it is broken up there is nothing more certain than it will be bursted within a very short time. Let the people who have paid an exorbitant price for their fuel take heart. No such combination is of long life in this country.

Space at Chicago.

Advices received by the International Exhibitors' Association of the Stewart Building, New York, from Chicago, contain an important statement made recently by Director-General Davis. He announces that of 3,642,812 square feet of space in the World's Fair buildings, only 214,476 square feet remain to be assigned to exhibitors. This showing is considered to be a sufficient answer to numerous complaints of the delay in assigning space to applicants.

The Director-General further states that the chiefs of the various departments have made a better record in this respect than in previous expositions. He says that it is always necessary to hold a certain area of space in reserve for first-class exhibitors who want to come in at the last moment, rather than to give the space to inferior concerns, simply because the latter forwarded their applications early.

Director-General Davis's statement shows that foreign countries have been given 1,419,517 square feet of space, and American exhibitors are allowed 1,787,263 square feet. Besides the 214,476 square feet of space unassigned in the various buildings, 211,465 square feet have been reserved for restaurants and other concessions.

In the matter of the space already assigned to domestic exhibitors: The committee from the International Exhibitors' Association, who were recently in Chicago, states that they were informed by the officials that in nearly every instance the space which had been allotted was from 30 to 50 per cent. less than the amount applied for—therefore it is expected that a large number on receiving their allotment will refuse to make an exhibit on account of the limited amount of space offered them, and that this space so rejected will then remain to be assigned to many intending exhibitors whose applications were received at a later date. It is expected, therefore, that many assignments will yet be made as soon as the officials of the Fair are able to re-allot the space rejected.

The American journal *Science* is deservedly severe on our weights and measures, which are so numerous that we may be said to have no system of either. A stone weight of a living man is 14 pounds, but a stone weight of a dead ox is 8 pounds, a stone of cheese is 16 pounds, of glass 5 pounds, of hemp 32 pounds, of flax at Belfast 16¾ pounds, and at Downpatrick 24 pounds; while a hundred weight of pork is 8 pounds heavier at Belfast than it is at Cork—another injustice to Ireland. A barrel of beef is 200 pounds, butter 224 pounds, flour 196 pounds, gunpowder 100 pounds, soft soap 256 pounds, beer 36 gallons, tar 26¼ gallons, while a barrel of herrings is 500 fish. "Yet," the paper from which these examples have been selected adds, "can it be believed, the old system is taught in every school in England, and the cruelty inflicted upon the brains and the tempers of the young, to say nothing of the loss of time and the cost, cannot fail to lodge a grave responsibility upon the Legislature which permits such a condition of things to exist."—*The Engineer.*

It is not always in the great things of life, or what we call the great things, that heroism stands out prominently. The recent instance of a young man—a mere boy—in an up-town building, who stood to his trust and ran the elevator, of which he had charge, up and down to remove the people while the building was burning, shows a heroism not often excelled on the field of battle.

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Marine Engineers.

Mr. Lawrence Tomlinson, chief engineer of the "Umbria," has been having honors heaped upon him by the passengers of the ship, who look upon him as their deliverer, and by the Engineers' Club of this city, which entertained him at dinner, as did also the American Marine Engineers. The facts are probably very much as Mr. Tomlinson modestly puts them, *i. e.*, he did only what it was his business to do, and what every really good engineer fit to be trusted with such a position of responsibility as he holds would have done. It simply happens that he has taken the obvious course in accomplishing certain repairs at a time when it was of the utmost importance. The section of shaft, 25″ in diameter, 20 feet 1½″ long, and with fifteen solid collars 3¼″ thick and 36½″ diameter upon it, the space between the collars being 6½″, broke (though not entirely through) between two collars. By drilling and chipping, gaps were cut in the collars each side of and next to the break, and three steel bolts were put into these, drawn up tight and held in place by a strap which passed around them. It is morally certain that, in his long experience as an engineer, Mr. Tomlinson has done many things more difficult than this. It was a creditable job of repairing, but in our opinion the incident serves better to illustrate the fact that the engineer and his department are of the greatest importance in a modern steamship, than it does to show the special talent or ability of any one on board the "Umbria." All engineers who have charge of the steam department in such vessels as the "Umbria" must have considerable ability, and they do have far more ability than was necessary to repair this break. The honors bestowed upon Mr. Tomlinson are well deserved, but at the same time we think it should be more generally recognized, as Mr. Tomlinson himself recognizes, that the incident is merely one which enables the public to come a little nearer understanding what are the duties and the responsibilities of engineers of steamships generally, and how much the safety of ships and their passengers depends upon them.

Assignment of Space at Chicago.

It seems to be more apparent, as time goes by, that there is going to be considerable dissatisfaction regarding the apportionment of space to exhibitors at Chicago, and there are increasing complaints of the delay in letting intending exhibitors know how much space can be assigned them, of the great reductions of the space asked for, and of alleged discriminations between exhibitors and between different sections of the country. To judge from press reports, these complaints are by no means confined to the machinery department, though we ourselves naturally hear most of complaints in this department, the most common of these being that discrimination is being made between concerns who are located in or near Chicago, or have representatives there, and those who are so unfortunate as to be located elsewhere, and to have no branch house or representative in that city.

The experience of a concern in this State which manufactures lathe and drill chucks seems somewhat peculiar. Application for space was made by this concern July 12th. August 9th a blue-print was sent in accordance with request, to show what use was to be made of the space asked for. Nothing was heard from this until November, and then nothing definite. A letter of inquiry finally addressed to Director-General Davis was referred to Chief L. W. Robinson, who gave no definite information, and finally, when asked in December for reasons for the delay, he said that no applications received after the 15th of July were being considered, and that space would probably not be assigned on this application, which was made the 12th of July.

Now the *Journal of Commerce*, which is published in Chicago, and possibly speaks by the card, publishes a rather "high and mighty" editorial regarding the matter of assignment of space, in which it speaks of the "army of discontents" who are to be notified "that they cannot get into the Fair," and says that: "Obscure concerns and others rated low in the commercial world, who would probably be unable to make an exhibit in harmony with the dignity of the Exposition, will stand no show of getting space." Of course, it is quite natural that a comparatively new concern, not rated high commercially, but who may have the latest and best machine in its line, nevertheless, should be found among the "great army of discontents," if this is the principle upon which space is being assigned. In any given line of machinery it is very possible that the newest and most interesting machine in that class might be made by the very concern rated lowest commercially.

At the same time it should be remembered, we think, that the task which Director-General Davis and the chiefs of the various departments have had to perform has been no slight one, and it is almost certain that any course that might have been possible for them or any others in their positions to pursue would have been apt, under the circumstances, to have been criticised adversely. Some light is thrown upon their side of the question on another page of this issue.

The Speed of the "Bancroft."

The reports so far made public with regard to the performance of the U. S. practice cruiser "Bancroft" are exceedingly favorable to that vessel and creditable to her builders, the Samuel L. Moore & Sons Co., of Elizabethport, N. J. It will be remembered that we have quite fully illustrated this vessel and her machinery, and it is gratifying to know that upon trial she has proved her ability to so far exceed the contract requirement of twelve knots per hour, as to make it probable that her builders will receive as a premium about $45,000 above the contract price.

The method of determining her speed is a new one, which has been introduced by Chief Engineer Commodore Melville, and consists essentially in first standardizing the screw, this being done by running the vessel over an accurately measured mile course, and making careful comparisons between the observed speed of the vessel and the number of revolutions made by the engines. By a series of such observations the ratio between the rotative speed of screw and the rate of the vessel is definitely determined, and then, during the four-hour run at sea, the speed of the screw, or the number of revolutions made by it, are taken as indicating the speed of the vessel. This transfers the actual measurement of the speed of the vessel from the conditions where it is almost impossible to determine this accurately, to conditions where it is quite possible to determine it with the greatest precision, and it is reasonably certain that a given speed of screw will produce a given speed of the vessel, this having been pretty conclusively shown by the experience of the engineers of transatlantic steamships, who declare that under ordinary conditions they can tell, with considerable accuracy, how near they may be to port, by looking at the revolution counter at any time, and that the total number of revolutions during a transatlantic trip varies surprisingly little.

A parade of unemployed men recently took place in Montreal to protest against the employment of sleds in place of street cars, the sleds having been adopted as better fitted to cope with the heavy snowfall. The ground taken by the men was that by thus avoiding the necessity for clearing the tracks of snow, they were thrown out of work. It is a curious commentary on our civilization when a method of overcoming a difficulty becomes a hardship; and the longest and most laborious way of doing it seems to a large class of men to be the best way. The conclusion is inevitable that there is a lack of adjustment somewhere in the social machine.

John F. Webster.

At his home in Springfield, O., on January 17, Mr. John F. Webster, of the Webster & Perks Tool Co., died of kidney disease, at the age of 45 years.

Mr. Webster was naturally one of the very best of mechanics, and he never let an opportunity pass to add to his store of knowledge regarding tool making and manufacturing operations.

His acquaintance with them was extensive and intimate, and his talent for organizing systems of manufacture, designing and building the necessary machines and tools for them was of a very high order. He possessed, too, a rare faculty for inspiring in the minds of those associated with him a liking and an enthusiasm for mechanical matters, his influence in this direction having been of the greatest value to very many who had the good fortune to be associated with him.

As a man and a citizen also Mr. Webster was universally esteemed and respected, and his wide circle of acquaintances will recognize in his untimely death a personal and severe loss.

A large part of Mr. Webster's experience was gained in sewing machine manufacture, he having invented a machine and been superintendent of the shop in Canada in which it was manufactured. He was a member of the American Society of Mechanical Engineers, joining in 1884.

The social reunion at the house of the A. S. M. E. was held the evening of the 26th of January, according to programme, and the hundred or more people who enjoyed the evening had an opportunity to judge something of the degree of success attained by the amateur photographers of the California expedition. The lantern slides shown under the engineering direction of Prof. Hutton were much enjoyed, and revived very vivid memories of the trip. Most of the slides shown were made by Messrs. Wilfred Lewis, of Philadelphia; William B. Cogswell, of Syracuse; C. W. Hunt, of New York, and Prof. Jacobus, of Hoboken.

Literary Notes.

POOR'S HAND-BOOK OF INVESTMENT SECURITIES.—The third annual volume of this hand-book has been issued, and fully sustains the expectations caused by its predecessors. Within its 986 pages is to be found in classified and tabulated form about all the important facts that one may wish to know regarding any proposed investment, whether it be railroad or industrial stocks, municipal or other bonds. The statements contained in the volume number 2,666, of which 1,897 cover the financial condition, revenues, etc., of an equal number of counties, cities and towns throughout the country. It is evident, even from a cursory examination, that the preparation of this volume has involved a vast amount of labor—the results of which are of the greatest value to those who are in any way interested in investments. It is published by H. V. & H. W. Poor, New York.

QUESTIONS AND ANSWERS.

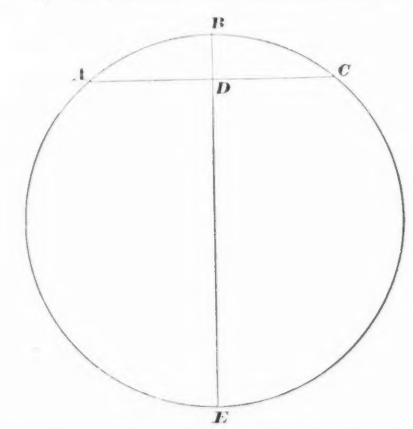
Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(40) G. M. M., Chicago, Ill., writes: Please answer through your columns if there is a book published treating on steam piping; if so, please give the name of the author, or you may be able to refer me to articles treating on this subject published in pamphlet form. *A.*—If you refer to steam piping for heating purposes, "Steam Heating for Buildings," by W. J. Baldwin, is a good book.

(41) T. J. O., Marion, Ind., writes: I am getting up a device for use in a greenhouse, the success of which depends on the amount of wear of the iron rope that I am using. The rope is composed of 12 strands of No. 21 B. W. G. iron wire, and is about $\frac{3}{16}$ inch thick. The rope is given three turns around a shaft $1\frac{3}{8}$ inches diameter, and drawn tight enough to prevent slipping when raising a weight of 40 pounds. The shaft will make about 15 revolutions per day on an average. Do you think this rope will stand the wear for several years? *A.*—No; the shaft around which it is wound is too small in diameter. 2. I find with the rope now in use there is considerable elongation. Will this be constant? *A.*—If the stress in the rope is well within the elastic limit, and made to work on a sheave of suitable diameter, the elongation will cease.

(42) A. and B., New York, write: Kindly say which of the following statements is correct? A. asserts that water does not exist at a temperature above 212 degrees, even in a boiler where the pressure is above that of the atmosphere. B. says that boiling water always has the same temperature as the steam which is produced from it, and that when the pressure rises above that of the atmosphere the temperature of the water rises above 212 degrees. *A.*—The statement of B. is correct. When steam is in contact with the water from which it is generated, the steam and water have the same temperature. A rise of pressure cannot take place without a corresponding rise in temperature. The physical condition of saturated steam is such that it is ready on the smallest increase of pressure, or decrease of temperature, to yield some portion of liquid. For a given pressure there is one temperature and one density.

(43) J. T., Johnstown, Pa., writes: Please inform me how to compute the diameter of a circle from a given segment. *A.*—Let *A B C D* be the given segment, its height *B D* and the length of the chord *A C* being known. Square one-half the length of the chord, and divide the product by the height *B D;* the quotient will be the length of *D*



E; add to this the height *B D;* the sum will be the diameter *B E* of the circle. If, for instance, the height *B D* is 3 inches, and *D C*, one-half the chord, is 6.4 inches, then we have for the square of *D C*

$$6.4 \times 6.4 = 40.96.$$

Dividing this by *B D* = 3 inches, we have $\frac{40.96}{3} = 13.65$ inches for the length of *D E*, and $13.65 + 3 = 16.65$ inches for the diameter *B E*.

(44) T. W., Buffalo, N. Y., writes: Please inform me as to the standard formula for computing the nominal horse-power of a steam engine. I have seen so many ways that I am somewhat puzzled as to which is the correct one. *A.*—There is no standard formula for computing the nominal horse-power of a steam engine; in fact, it can scarcely be said that the term "nominal horse-power" has any definite meaning, since there are a number of different rules by which it may be computed. Thus there is the Admiralty rule for marine engines, Mr. Bourne's rule for condensing and non-condensing engines, and Watt's rule; and in addition numerous engine builders have what may be called proprietary rules. In the present advanced state of steam engineering this term has no place, and should be condemned, as it may lead to disappointment, or, worse, to deception.

(45) J. A., Greenbush, N. Y., writes: Please inform me how to compute the safe steam pressure in a cast-iron pan whose sides are $\frac{1}{2}$ inch thick, and the exposed surface to the steam pressure of each side is 3.157 square inches. *A.*—From your description we assume that the pan is simply a hollow cube, the inner surface of each side containing 3.157 square inches. For so small a casting it is sufficient for practical purposes to compute the safe shearing resistance of each side of the cube. The length of the side of each surface is equal to the square root of 3.157 square inches = 1.78 inches, and the surface to be sheared is equal to $4 \times 1.78 \times \frac{1}{2} = 6.23$ square inches. Assuming that 4,000 pounds is the safe shearing stress for cast-iron, the total resistance to shearing will be $6.23 \times 4{,}000 = 24{,}920$ pounds; dividing this by the area of one surface (3.157) we have $\frac{24{,}920}{3.157} = 7{,}893$ pounds per square inch.

(46) T. D. S., New York, writes: The question was raised recently: Why should the steamship "Umbria" go back to England for a new shaft? An intelligent Englishman, and also an engineer, made the claim that such a shaft as that steamer required could not be forged in America; in fact, it could only be done in one establishment in England, namely, Whitworth's. Now to settle the matter and afford information to many Americans who are not competent to decide as to how far America is behind in forging large shafts, will you please enlighten us and oblige? *A.*—We believe the "Umbria's" shaft could have been forged here; in fact, any shaft that can be forged in England can also be forged in this country. The Cleveland City Forge and Iron Co. has made forgings which finished to 32 inches diameter and 35 feet long over all, the forged weight being something over 40 tons. The Bethlehem Iron works is also well fitted up for exceedingly heavy forgings.

(47) E. P., Birmingham, Conn., asks: Does a horse which exerts a pull of 500 pounds through a space of 66 feet per minute lift 33,000 pounds one foot high per minute? *A.*—The horse is doing work equivalent to raising 33,000 pounds 1 foot high per minute. This is simply a question relating to rate of work performed, and is computed by multiplying the force exerted by the distance through which it acts in a unit of time. Here we have $500 \times 66 = 33{,}000$ pounds raised 1 foot high per minute; in steam engineering this amount is called one horse-power. 2. What was the standard horse-power taken from? *A.*—It was established by Watt, who estimated that a horse could lift a little less than 33,000 pounds 1 foot high per minute, but to make sure that his engines would do as much work as the horses, adopted the above as the measure of one horse-power, and this standard has since been adopted by universal consent. 3. Can a good, strong horse perform that much work? *A.*—If a good horse works 4 or 5 hours a day only, we believe it can do an equivalent amount of work, but it is generally admitted that for a longer period this estimate is too great.

(48) S., Syracuse, N. Y., writes: Your answer to Question 528, in your issue of December 1, 1892, needs reconsideration. The volume of a square thread on the surface of a cylinder is precisely equal to the volume of a rectangular collar on the same cylinder, having the same outer diameter and axial face for the same angle of revolutions. *A.*—We thank our correspondent for calling our attention to the error in our answer to Question 528. Let *a b c d* in Fig. 2 be a surface lying in a plane through the axis of the screw, then the volume of one turn between the threads of the screw is determined by the product of the area of the surface *a b c d* by the circumference of the circle whose radius is the distance from the center of gravity *G* of the surface, to the

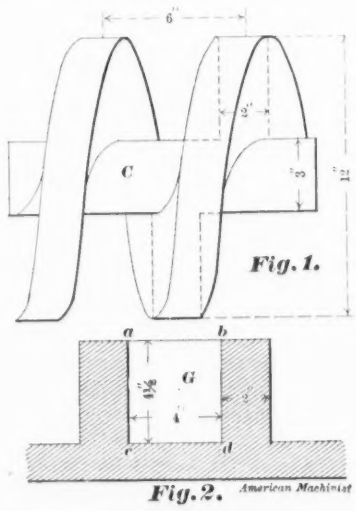


Fig. 2. American Machinist

axis of the screw. According to the dimensions given in accompanying sketch, the area of the surface *a b c d* is $4.5 \times 4 = 18$ square inches; the radius from its center of gravity *G* to the center of the axis of the screw will be $3\frac{3}{4}$ inches; the circumference of the corresponding circle will be 23.5619 inches, and the volume of the space will be $23.5619 \times 18 = 424.1142$ cubic inches, instead of 437.58 cubic inches, as previously given.

(49) J. J., New York, writes: We have a horizontal tubular boiler in this city; its dimensions are 62 inches diameter, 17 feet long, shell $\frac{11}{32}$ inch thick, 105 tubes 3 inches diameter, natural draught. The transverse seams are single-riveted; some of the rivets were burnt before they were put into the boiler, and I find that the heads of some of the rivets have dropped off. The boiler is placed on a bad foundation, which is not able to carry it, and allows it to settle; the boiler does not remain level, and sometimes it leaks. The boiler has been re-set about a half dozen times, but even now the bricks in the walls are so loose that they can be picked out by hand. Some of the rivets in the bottom of the boiler have also been renewed, but I cannot find out the conditions of the rivets in the sides of the boiler which are covered by the walls; what can be done to find out their condition, and how can defective ones be replaced without taking out the tubes? Please inform me through your columns what I can do in the matter without running the risk of losing my position and license. *A.*—Your duty is to report the condition of the boiler and its setting to your employer, and insist on having the boiler thoroughly repaired and put in a safe working condition by responsible boiler makers, and a suitable foundation laid, and the brickwork re-set under the supervision of a competent mechanical engineer. If your employer pays no attention to your report, and allows the unsafe condition to remain, he is, to say the least, guilty of criminal negligence, and should be reported to the Police Department.

(50) C. W. R., Geneva, N. Y., writes: Why is sheet copper used around the ends of both old and new tubes of boilers before they are expanded in the head? Will not copper used in connection with the iron in that way form a sort of galvanic battery with the action of the water? We had a discussion with friends regarding the same; one takes the ground that it will make a battery when put together this way, and another friend states that all boiler tubes used in locomotives have a copper ferrule put on the outside of each tube where it is expanded into the head. We have thought that this was done on account that locomotive boiler tubes are oftentimes taken out, and if they get to leaking they can be more easily expanded with the pressure on; where, if they are all iron, this cannot be done so easily. Please explain if all locomotive tubes have copper ferrules, and if so, why, for the benefit of your many readers, as well as the writer. *A.*—In using water containing certain salts, a rapid corrosion, usually ascribed to galvanic action, is liable to occur whenever copper, brass or bronze is in metallic contact with the boiler at any point. Corrosion due to this cause is more liable to occur in marine boilers than in locomotive boilers, probably on account of the difference in the quality of water used in these boilers. In locomotives the ends of the tubes in the furnace are liable to be exposed to cold currents of air when the furnace door is opened, which in time will cause them to leak and give considerable trouble. To avoid this leakage as much as possible, short copper ferrules are inserted between the tubes and sides of the holes in the tube sheet; the tubes should be beaded over, to prevent the ferrule from dropping out, and at the same time protect the ferrules as well as the ends of the tubes from wear caused by impact of the unconsumed fuel which is drawn against them. Copper ferrules are seldom placed on the front ends of the tubes in locomotive boilers, although the use of ferrules on these ends we believe to be good practice and advantageous when the tubes have to be taken out for making repairs, because with ferrules, the holes through the front tube sheet, through which the tubes must be drawn, are necessarily larger, and will permit a slight incrustation on the tubes to be drawn through the holes, and therefore involve less labor and time than when the holes are smaller.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gear Advertisement is always on page 11.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N. Y.

Forming Lathes Mer. Mach Tool Co., Meriden, Ct.

Tool Holder: Armstrong Bros. Tool Co., Chicago.

New lists of cutters. Brown & Sharpe.

Norway Rivets, Evans & Robertson, Cincinnati, O.

6-Spindle Turret Drills A. O. Quint, Hartford, Ct.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Drill Presses, with Tapping Attachments.
Gould & Eberhardt, Newark, N. J.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for standard Tool Co.'s Twist Drills.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Castings for small and medium sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Clayton Air Compressor Works, 43 Dey St., N. Y. Compressors for experim'ts to 300 lbs. pressure, $50.

For Cypress Tanks and Vats, address W. E. Caldwell Co., Floyd and Main Streets, Louisville, Ky.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

"Shapers (Double Triple Quick Stroke")
Trade Mark.
Gould & Eberhardt, Newark, N. J.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

For best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves, T. Kieley, 11 W. 13th St., N.Y. Send for des'n.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., corner Canal and Washington Sts., Chicago, Ill.

Combination Gear Cutters in stock. Vertical Miller, Drill and Slotter in one machine, worth it. weight in gold. R. M. Clough, Tolland, Conn.

We electrotype illustrations and advertisements for manufacturers. Prompt and thorough service. Send for estimates. A. Mugford, Hartford, Conn.

Roper's Practical Handy-Books for Engineers & Firemen; Descriptive Catalogue mailed free. Edward Meeks, Pub., 1612 Walnut St., Philadelphia, Pa.

Gear Cutters, Auto. Specially adapted for Motor Gears and all other style Gears.
Gould & Eberhardt, Newark, N. J.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., Western Agent.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases,
31 Nassau Street, New York.
Send for Brief History of Patent Legislation.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Several Ways of Molding a Four chambered Ventilator Shaft—I.

BY S. BOLLAND.

The following excellent example may with propriety be termed advanced practice in the art of molding. Unvaried success in producing castings of this type is only possible when the most skillful workmen are employed to produce it.

This particular casting has been selected for illustration on this occasion, because in

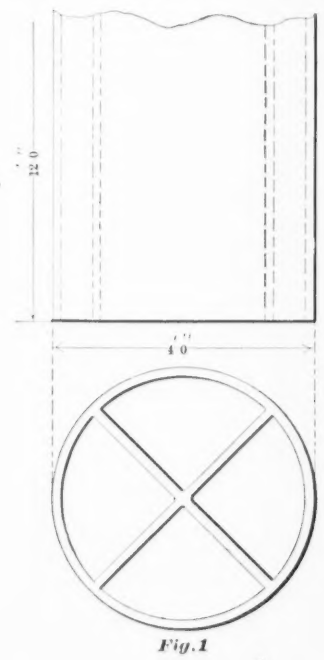


Fig. 1

its numerous and varied phases under altered circumstances, superinduced by the lack of facilities in some foundries for making such work readily, it presents a wide range of difficulties that can be successfully met, only when the best efforts of the most skillful artisan are put forth.

At Fig. 1 is shown the plan and elevation of a four-chambered ventilating shaft 4 feet diameter, 11 feet long, and $1\frac{1}{4}$" thick all through. The casting, as seen, is simply a plain cylinder with internal webs that intersect each other at right angles at the center, extending throughout its entire length and forming four separate compartments, or chambers.

Founders having no facilities for molding

such a casting vertically, in loam, but who are in every sense well equipped for its production in halves, in green sand, would naturally hesitate about sub-letting the job at a considerably advanced figure, if bolting the halves together violated no part of their contract.

Fig. 2 is plan and elevation of the half casting for this purpose, showing the web

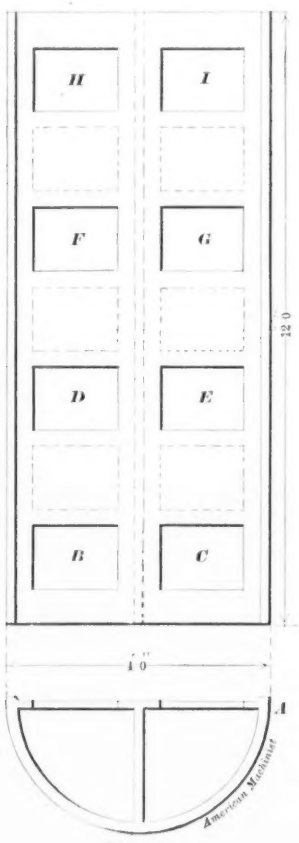


Fig. 2

at *A* to be slightly reduced in thickness, and still further lightened by the eight openings, marked from *B* to *I* respectively for one-half; six similar openings in the other half to be set exactly between, as indicated by the broken lines, giving space sufficient for a bed of cement that is to be applied for the prevention of leakage from one chamber to another.

The subject now resolves itself into the molding of two castings, one of which, the half, is to be cast horizontally, in green sand with dry sand cores, and the whole one vertically in loam; with cores after various methods, to be illustrated further on. As previously stated, these castings are good examples of their kind, calling forth and developing ideas of molding, which, if intelligently understood, may be made of universal application.

We will first consider the half one in green sand (Fig. 2), and before we sit in judgment on what appears so plain a job, let us examine into some of the chief features connected with it.

Firstly. The core weighs in the neighbor-

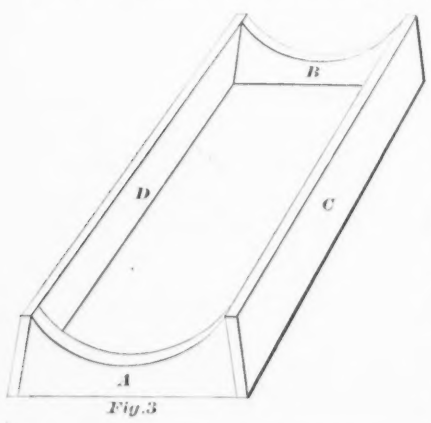


Fig.3

hood of seven tons, a large proportion of which weight must be borne on studs necessarily; this, of course, must be provided for by preparing good foundations for the studs and a more than ordinarily solid core, the latter to be divided in such manner as will be most convenient for drying, handling, setting, etc.

Secondly. The pressure under this core is over twenty tons, and this pressure must be resisted by a judicious distribution of chaplets and studs which must rest on suitably provided iron bearings in the cores, as the latter must be held in position by a greater weight above, or, what is better, by a system of binders sufficiently strong to resist the upward pressure. We must not omit to remember here that pressure is exerted in every direction as long as the metal is in a molten condition, consequently the green sand mold needs to be well made if it is expected to retain its original shape under such a test.

Thirdly. As such a casting would weigh about three tons it would be judicious to divide the iron, pouring one-half at each end by a system of runners cut under the core, as described in chapter on "Pouring," etc.," AMERICAN MACHINIST, September 29 and October 3; this would strengthen the ends of the casting by insuring a supply of hot iron, at those parts, to the last, and would sensibly lessen the damage from abrasion which is unpleasantly noticeable when large quantities of iron enter the mold at one place.

Starting with the above knowledge of the chief requirements, we are more than half equipped for the undertaking before a blow is struck; how much of this power of introspection is lacking amongst us, as a class, is only too well known, and to the lack of this ability to judge of the needs and requirements in the case, most of the disasters that are constantly occurring may be traced, plainly demonstrating that we as molders are not equal to the demands on our ingenuity and judgment, owing to the scarcity of education which prevails.

The magnitude of this job demands a reliable substitute for the prevailing method of "rolling over," and this may be found in the bed sweep, or former, shown at Fig. 3, consisting of two boards *A* and *B*, equal to the circle of the shaft pattern and held together by the straight edges, *C* and *D*, the length of which corresponds to the length of the pattern; there must be width sufficient to make the ramming of the remainder an easy matter after the pattern has been set upon the formed bed.

Let the reader turn to Fig. 4, which is a sectional view of the whole mold when everything has been achieved up to the

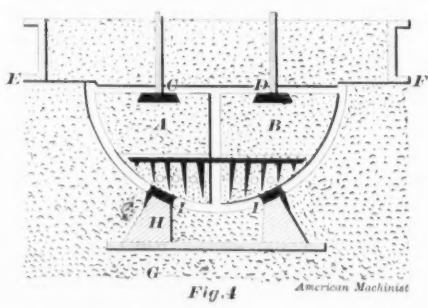


Fig.4

closing on of the cope, but before we attempt any description of the methods adopted for the accomplishment of what is there seen it will be best to understand the system of coring as here applied. Literally speaking, this job can be made with two cores, formed on strong arbors full length of the casting, but preference may, with considerable reason, be made of the means herein represented, inasmuch as it accomplishes the object with equal facility by a number of pieces that are soon dried, and can be readily handled, whilst the arrangement of the core iron for the bottom sections of core makes what, in either case, would be a tedious undertaking, a very simple piece of work.

To set these cores on either side of the web separately would be a critical operation, on account of the tendency to slide off the studs towards the center. This difficulty is effectually met in this case by uniting the two bottom sections of cores at the bearing *C*, Fig. 5; also at *A* and *B*, at which points the core iron is allowed to pass through the casting, thus making one firm core out of both; the irons are easily snapped off when the casting is cleaned.

Fig. 5, *D*, shows the end view of frame for making this section of core; the frame is made one foot longer than the half of the shaft, and simply rests over the core iron, as shown by broken lines at *D*. This frame and a smooth plate is all the core box required for this part of the job, as the core can be easily turned over when dry, and lifted into the mold with ropes round the cross-bars at *B*, *D* and *E*. By this means staples for lifting are unnecessary, and the surface is consequently left clear for the upper sections of core to rest on.

The upper cores *A* and *B*, Fig. 4, four in number, may be made on a smooth plate with the upper face down, to be reversed again when dry, in which event sides and ends with a temporary preparation for the circle on one side will be all the core box needed at this part. Remembering the amount of pressure that this core is called upon to resist, there must be no mistake about having the stud plates *C* and *D*, Fig. 4, to rest firmly, iron and iron, on whatever system of core irons may be used for the purpose. On the other hand, remembering the amount of weight that the bottom sections must sustain, equal attention must be paid to the selection of material that will hold the weight without fracture at the point of contact with the stud; but should the strength of the material used be found inadequate to the work, then make such an arrangement as will insure the stud to press directly against the core iron, in which case assurance is made doubly sure.

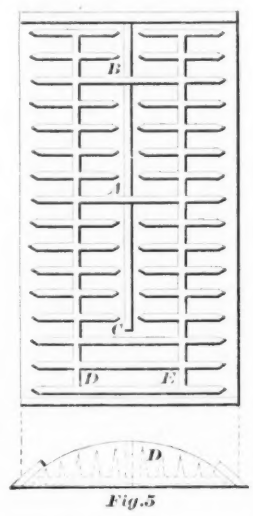


Fig.5

Supposing our cores to be all ready we will at once proceed to make the mold, giving reasons for the several operations as we proceed. The mold, as shown at Fig. 4, is contained in the floor, but it is far preferable to have a lower box constructed of stout sides, with external flanges to correspond with those at *E* and *F*, the depth of which may be about 2 feet, standing out of the floor about half its depth. These sides must be connected with extra strong cross-bars extending down under the job, making it only necessary to clamp, or bolt, the two flanges at *E* and *F* together in order to secure anything that may be cast therein; the upper flange can be utilized for holding down cores, as in this case, after the manner shown in chapter on "Studs, Chaplets, etc.," AMERICAN MACHINIST, October 20, 1892.

After a good cinder bed has been laid down at *G*, 12 inches below the bottom of the mold, ram solid to within 6 inches, and set down the bed former, Fig. 3, at such depth as will bring the pattern, when set thereon, even with the joint of the flask at *E*, Fig. 4. The former will serve as a guide for placing the anchor plates *H* in such numbers and position as will best serve the purpose of supporting the cores; a knowledge of the weight these must carry will suggest the propriety of having them on solid ground; otherwise they will be pressed downward, and a consequent diminution of the thickness at the bottom of the casting ensue.

The anchor plates satisfactorily set, proceed to ram old sand within the frame to within one inch of the surface, when the whole must be vented down to the cinders, after which the facing sand can be applied by tramping an extra thickness all over as evenly as possible; the surplus can then be struck off to the frame. After the frame has been lifted out, continue the ramming to the edge of the formed bed, set on the pattern and proceed to ram along the remaining portion of the pattern in the usual way.

This mode of bed forming will be found infinitely superior to any other for "bedding in" for not only large circular, but all classes of work with surfaces more or less irregular.

As we close this mold we realize very sensibly the advantages gained by the methods adopted for molding it. We know that the foundations *H* are solid; that the studs *I I*, in consequence of the wedge attachment at the back, are immovable thereon; that the bottom section of cores, safely held together by the cross-bars, cannot be changed from their position, and constitute a safe bed whereon to set the upper cores without fear of failure; all this we say conspires to make the closing of this mold a marvel of simplicity, dispatch and safety.

Our Chicago Correspondents.

We publish from time to time communications from our correspondents at the exposition grounds in Chicago. These communications, of the authenticity of which we are assured, go to show the great advances being made there in the way of putting everything in connection with the fair into proper shape for the coming exhibition. It appears to be, however, quite evident that the space, although something enormous in its size, is inadequate for the purposes for which it was intended. American exhibitors are already finding much fault at the lack of accommodations given them, and foreign exhibitors are scarcely in better humor in regard to this. Still we think the wisdom of the management will so arrange matters that nearly all shall have a fair opportunity to exhibit their products. It seems as though the scope of the exhibition was hardly taken in view at the start. It has mapped itself out into greater proportions than was ever thought of, but it does not follow from this that intelligent management and careful conserving of space will not give nearly every one who desires to exhibit at the fair a proper opportunity for doing so—perhaps not so great an opportunity as desired, but such an opportunity as will fairly represent what he has, and so in the end we trust that all will be satisfied. It has been thought that some of the recent European exhibitions could not be equaled in this country. We see no reason to believe in this. We think that the exhibition at Chicago will more than equal anything that has taken place previous to this. We, of course, trust that this will be true, not in any sense as trying to belittle any other exhibition, but as one succeeds another, so the last one should be the greatest. We are of the opinion that those who view the Chicago exhibition will go away satisfied that it is the largest of them all. After that will undoubtedly come an exhibition that will excel the Chicago exhibition; but so far as that goes we are fairly well satisfied that it will be up to its date the largest ever seen.

Probably there will be nothing shown at Chicago that can compare with the showing of machine tools. There is no question that the showing of these, both from this country and Europe, will be the most complete ever made in the world, and every one interested in this subject, as every mechanic is interested, will find there the finest assortment and arrangement of tools ever made in the world. It will be not only manufacturers, but mechanics, who will be interested in what they will see there. With some knowledge we have of what will be shown there we can safely say that the showing will be of the highest interest to both mechanics and manufacturers. In the way of steam engines we have no doubt the showing will be of nearly equal importance. To many it will be of even greater importance, because their inclinations will be more in that direction, but to all there will be an exhibition there which will be both interesting and instructive.

It has seemed to the citizens of New York that the exhibition should have been given here, but it is given in this country, and New York is not all the country. It went to Chicago. Now all should, and we believe are inclined to make it a great success. We predict for the Chicago exhibition the greatest success of any exposition ever held in the world.

Transportation Charges on Coal.

The Committee of the Legislature appointed to investigate the coal combine, to whose work we have referred several times, has presented its report, and it is instructive reading. Besides the familiar fact that the cost of coal to consumers has been increased for different grades from 38½ to 41½ per cent., the further and not so familiar fact is noted, that, though the modern machinery and appliances for handling coal enable it to be transported by rail with much less labor than almost any other class of freight, and the risk of loss is comparatively very slight, the transportation charges are much higher than upon others of our great products that are much more valuable per unit of weight. For instance, the freight charges for coal as agreed upon are nearly twice as high as for equal weights of wheat and cotton, while no one in possession of even the most elementary acquaintance with the business will doubt that the cost to the railroads of handling wheat and cotton is much greater than the cost of handling coal.

It must be that the reason for this is that the men who control the prices for the transportation of coal, and also control the bulk of its production, prefer to put their excess charges upon its transportation rather than upon its production, for the purpose of keeping down to the lowest limit the prices which private producers can get for coal at the mines, and the amount left in their pockets after paying charges upon coal to the seaboard, the condition of business thus brought about being made use of to suppress competition and gain complete control of the trade. To thus discriminate is a violation of the spirit if not of the letter of the law, and few things can be more certain than that sooner or later, and in some way, the practice will be stopped by the power of the community, which has already shown that it is sufficiently potent to at least cause the combine much trouble, and, in fact, to force some modification of its plans; among which is the ostensible withdrawal of the C. R. R. of N. J., though it is pretty well understood that this withdrawal affects the form only and not the substance of the agreement, at least for the present.

There is talk now of the New York Legislature being asked to fix a maximum price for coal, though it is doubtful if such legislation is practicable.

It would not surprise us if in the end the various States would be compelled for self-protection to condemn and pay for the roads, upon a fair estimate of their actual value, and then lease them to operating companies, under conditions that will protect the interests of the public. Of course there are objections to such a course, but it may become become necessary nevertheless.

MANUFACTURES

The Adams (N. Y.) Furniture Company has increased its capital stock from $46,000 to $100,000.

Work has been commenced on five of the buildings of the Denver Steel Rolling-mills Co., at Sheffield, Col.

The Alabama Great Southern's shops, at Meridian, Miss., are about completed, the improvements having cost about $200,000.

The Toledo (O.) works of the National Malleable Castings Company were destroyed by fire on the 4th inst. The plant will be rebuilt.

The new wire nail factory at Bridgeport, Ala., is now well under way. The factory will be 30x75 feet and the boiler and engine house 22x24 feet.

The capacity of the Shenango Valley steel plant at New Castle, Pa., is to be enlarged, and the present force of 250 employes increased to 300 or more.

The mills of the Andrews Iron Company, at Haselton, Ohio, have resumed, after making repairs and putting in new machinery. They report trade fair.

It is said that the Roanoke Machine Works, Roanoke, Va., will be increased in capacity 50 per cent., which will necessitate additions costing about $500,000.

The Fulton Iron and Engine Works, Detroit, Mich., is increasing its plant largely. The brass foundry is increased from a capacity of 8,000 pounds a day to 20,000.

The Enterprise Glass Works, at Beaver Falls, Pa., will resume on April 1, under a new ownership. Druggists' ware will be manufactured. The plant has been idle for a long time.

The Braddock (Pa.) Wire Works, employing 675 men, has resumed, after a five-weeks' shut-down for repairs. Many improvements were made, and six nail machines, requiring 24 additional men, were added.

The plant of the Brown-Bonell Iron Company, at Youngstown, Ohio, is again in operation, with sufficient orders to keep all departments running for some time. The iron frames for the new buildings have been placed in position.

The Ohio Steel Company at Youngstown is steadily pushing the work on its new plant, notwithstanding the severity of the weather. The superintendent is Thomas McDonald, who has just left a similar position with the Carnegie Company at Duquesne, Pa.

The E. P. Allis Co., of Milwaukee, Wis., began on its $400,000 additions recently. The first building to go up will be 300x400 feet, and will be devoted exclusively to the manufacture of large engines. The company now has contracts on hand amounting to $2,500,000.

At a meeting of the stockholders of the Rowell Box Factory Co., of Batavia, N. Y., held recently, it was decided to increase the stock from $15,000 to $25,000. The officers of the company are E. N. Rowell, president; F. S. Wood, vice-president; Chas. H. Rupprecht, secretary.

William Clendinning & Son, whose foundry and iron works at Montreal, Can., were recently destroyed by fire, have been voted a bonus of $30,000 and fifteen years' exemption from taxation by the town of St. Henri, Que., and they will proceed to erect large works there for the manufacture of iron pipe, stoves, etc.

There is to be a silver-plate factory started at Rockford, Ill. The directors of the new concern held a meeting recently, and elected the following officers: President, George Tongue; vice-president, Wm. Bengersdorf; secretary and treasurer, Claus Peterson; superintendent, John Newton; business manager, Charles Blewfield.

We have received a catalogue of the A. L. Swett Iron Works, of Medina, N. Y., illustrating and describing a complete line of castings especially adapted for use in connection with barns, shops and other buildings. It also illustrates an improved tackle block known as the "Novelty," the bearings of which are composed of steel rollers.

Messrs. Curtis & Curtis, of Bridgeport, Conn., and 74 Cortlandt street, this city, have issued a new catalogue of their die stocks and improved pipe-cutting and threading machinery, which is well illustrated, well printed, and well arranged. It should be in the hands of every mechanic who is interested in performing the operations for which these machines are designed.

Contracts for $90,000 worth of machinery for a new iron-mill at Minneapolis, Minn., have been divided between Pittsburgh, Leechburg, Pa., and Youngstown, O., firms. The amount of capital already subscribed and paid in is $500,000, and among the stockholders are James Lowery, the street railway magnate, and Mr. Pillsbury, the flour manufacturer. The buildings will be ready to receive the machinery about April 1.

The Morse Twist Drill and Machine Co., New Bedford, Mass., write us: We have been occupied to the limit of our capacity the past year, notwithstanding the help from much new machinery which has been constructed and purchased. You may learn within the coming few months of our having doubled our steam power, and gained proportionately in the distribution of some tools not altogether new to us. Certainly we enter upon the new year in good hope and expectation.

Among the new industries that are now being projected, is a large cotton factory to be built several miles north of Rome, Ga. Mr. J. W. Rounsaville, of Columbus, Ga., is engineering the new enterprise, and he says that it is a certainty. It will be built on the Chombess mill property, seven miles from the city, but will be identified as a Rome enterprise, as the main offices will be located there. The idea of Mr. Rounsaville to utilize the superior water-power in and around Rome is a commendable one, and will result in others doing likewise.

H. W. Knight & Son, manufacturers of pattern letters and figures for foundrymen's use on patterns, Seneca Falls, N. Y., write us: The condition of business on pattern letters and figures is exceedingly good. We find we did more business last year than ever before, and the present outlook is equally satisfactory. We have added new varieties to our line of goods, and have doubled the size of our plant, so feel in better shape than ever to fill orders. The heavy stock we constantly have on hand enables us to fill orders without delay, and gives us a firm hold on the trade.

The Backus Water Motor Co., of Newark, N. J., have issued two new catalogues, one illustrating their water motors, as arranged for furnishing motive power for almost every imaginable purpose where light power is used, and giving much information regarding the employment of light powers. The other catalogue illustrates and describes the fans made by this concern, these fans being adapted to ventilation, drying, and many other purposes for which a current of air is necessary. These are adapted to be driven by the motors referred to above, or from any convenient source of power.

Machinists' Supplies and Iron.

NEW YORK, January 28, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.75 to $15.25: No. 2, $14 to $14.50; Gray Forge, $13 to $14. Southern brands of good quality are obtainable at $15 for No. 1 Foundry; $13.75 to $14 for No. 2; and $12.75 to $13 for Gray Forge.

Scotch Pig—Coltness is quoted at $21; and $20 for Eglington.

Antimony—The market is easy and quiet. We quote L. X., 10½c. to 11¾c.; Cookson's, 10¾c. to 10¾c.; Hallett's, 10½c. to 10⅝c., and U. S. French Star, 10½c.

Copper—Producers continue to quote 12½c. for Lake Copper. No business is reported. Casting Copper is held at 11¼c. to 11½c.

Lead—The general asking figures are 3.90c. to 3.95c., although it is reported that 3.85c. has been accepted by second hand dealers.

Lard Oil—Prime City is quoted at 98c. to 99c.; Western on spot at 95c. to 98c.

Spelter—Several car-loads are reported sold at 4.32½c. for New York delivery. Agents continue to quote 4.35c. to 4.40c.

Tin—Business has been light at 20.05c. to 20.25c. for future delivery. Spot is offered at 20.10c., with bids of 20c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Salesmen on commission, to push a special line of mach'y. "Kirk," care of AM. MACH.

Wanted—First-class machinists. The Pond Machine Tool Co., Plainfield, N. J.

Mechanical draftsman, experienced designer, wants situation. Box 5, AMERICAN MACHINIST.

Wanted—Employment by 1st-class machinist and tool maker. Hartford, AMERICAN MACHINIST.

Mech. draftsman, 1st-class designer and practical man, desires engagement. Box 4, AM. MACH.

Designer & developer of fine mechanism & manager of men, seeks engagement. G. V., AM. MACH.

Mech. draftsman, graduate, 12 years' experience, desires to make change; best refs. Box 6, AM MACH.

Foreman, by expert machinist, exp'd in manuf'g and mod. machine shop practice; good designer of spec'l mach'y; 1st-class refs. H. G., AM. MACHINIST.

Wanted—Foreman in machine shop mfg. duplex steam pumps, employing 50 men. None but exp'd man wanted. Gardner Governor Co., Quincy, Ill.

Wanted—Position as traveling salesman, by practical machinist (American;) good worker; 2 years on the road. Box 98, AMERICAN MACHINIST.

Wanted—A situation as foreman by one of experience, and a practical tool maker and die sinker. Morris Dean, Ilion, N. Y.

Wanted—Position by designer & draftsman; exp. in mach. tools, steam, electric & hydraulic mach'y; technical graduate; shop exp. Box 100, AM. MACH.

Wanted—A draftsman; one who has had exp. in wood working machinery preferred; must be well up in modern draw'g room prac. Box 3, AM. MACH.

A foreman machinist wants similar or better position; light or heavy work; energetic and thorough; 35 years old, 10 years in charge of men, and means business. Address "J.," AM. MACHINIST.

A mechanical engineer, experienced in design and construction of steam engines, machine tools, etc., desires a position; New York or immediate vicinity preferred. Address E., P. O. Box 1,187, New York.

Bradley Hammers.

If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a BRADLEY HAMMER will soon pay for itself, by what it will save over any other similar tool. Send for circulars.

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AMERICAN FOUNDRY PRACTICE
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MOLDER'S TEXT BOOK,
Each $2.50, postpaid.
JOHN WILEY & SONS, NEW YORK.

Milwaukee, January 2d, 1893.

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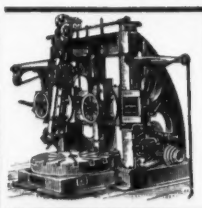
I have just put one of your 2-inch Balanced Valves for controlling feed pump from receiving tank operated by float in tank, to take the place of two different ones that have not given satisfaction; and if all your different products will give as good satisfaction as the valve is doing at present, I shall certainly be a convert to the Mason goods. I am,

Very truly yours,

JOS. BRADSHAW, Engineer Hotel Pfister.



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ASBESTOS
ASBESTOS SECTIONAL PIPE COVERINGS.

Non-Conducting Coverings for Steam and Hot Water Pipes, Boilers, etc.
ASBESTOS BOILER COVERINGS.
H. W. JOHNS MANUFACTURING COMPANY,
H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc.
87 MAIDEN LANE, N. Y. JERSEY CITY, CHICAGO, PHILADELPHIA, BOSTON, ATLANTA, LONDON.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—A young draftsman of some experience to work under instructions of an experienced M. E. on engine and boiler work. Address ——, stating experience, and salary exp'd, Box 95, AMER. MACH.

Foreman pattern maker thoroughly familiar with machine tool, steam engine gearing and special machinery desires to make a change; Mass., Conn., or R. I. preferred. Foreman, AM. MACHINIST.

Wanted—At once, by the Webster Mfg. Co., a number of first-class tool makers on fine work. Apply at once, stating experience in full, wages expected, and earliest date of commencement, Chas. E. Davis, Chief Eng'r Webster Mfg. Co., Chicago, Ill.

Wanted—Foreman machinist; must understand drawings and manuf'g work by use of jigs and templates up to best modern practice; a chance to grow for a live man. Answer, giving full particulars and references, Box 96, AMERICAN MACHINIST.

Wanted—Two active and intelligent young men with some machine shop and drawing room experience for similar service, with the ultimate end of becoming traveling salesmen. State age, previous experience, and furnish references, Manufacturer. Box 260, Buffalo, N. Y.

A 1st class mach. and draftsman may secure a permanent pos. as supt., with a concern mfg. mach'y for saw-mills, flour-mills, also iron work for bridges, buildings, etc.; location within 200 miles of Chicago. "Superintendent," care of *Northwestern Lumberman*, Chicago. State references, exp., and salary.

Wanted—A first-class superintendent to take charge of architectural and structural wrought-iron works who employ 30 to 60 men; one who understands drawings, mak'g estim's & laying out work; positively state salary expected. Address Architectural Iron Worker, AMERICAN MACHINIST.

Wanted—Foundry foreman, who is accustomed to 1st-class machinery castings weighing from one pound to ten tons each, Corliss engine beds, dry sand cylinders, loam work, etc. None but 1st-class man need apply, giving exp., refs., and wages exp'd. Gifford Bros., Founders & Machinists, Hudson, N.Y.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Gang & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Engines, special and gen. mach'y designed; ideas developed. A. W. Jacobi, 136 Liberty St., N. Y.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Splendid plain slide rest lathe, 12" swing, $30; screw-cutting lathes, bargains. 229, AM. MACHINIST.

For Sale—New Tools: Iron Planers, plane 24"x 24"x5 feet, $350; Screw-cutting Engine Lathes, 20" swing by 8-foot bed, $275. F. & A., AM. MACH.

Wanted—Hardware specialties to build. Send 25 cents for "Eureka Knife and Shears Sharpener." W. A. Smith & Co., 227 Eddy St., Providence, R. I.

To Inventors—An American wishes a new invention of merit for Europe; has over 20 years' experience abroad, large acquaintance, highest standing, and capital. Address P. O. Box 2911, Boston, Mass.

Special, experimental or other light machinery manufactured. Best equipped shop in the West for fine work. Manufacture one of the best hollow spindle bench lathes for the tool room or for manufacturing. Write us. Moseley & Co., Elgin, Ill.

We will pay 50 cents each for copies of the AMERICAN MACHINIST of December 25, 1886, issue; must be unsoiled and in good condition. AMERICAN MACHINIST PUBLISHING COMPANY, 203 Broadway, New York.

Parties wishing machinery of any kind manufactured, either in large or small quantities, please address the undersigned, who own near Boston a large and well-equipped shop with the tools of latest patterns; responsibility and satisfactory work gur't'd. Manufacturers, P.O. Box 5,305, Boston, Mass.

For Sale—One-half or the whole interest in a good patent for a useful machine. The first machine is built, and can be seen working under steam; good cause for selling. Price for patent, patterns and first machine, $5,000. Address P. A. M., care of AMERICAN MACHINIST.

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1 25 in. x 25 ft. L. W. Pond, Compound Rest, Rod Feed. Good order
1 17 in. x 8 ft. Blaisdell, Rise and Fall Rest. Good as new
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1 30 in. x 30 in. x 8 ft. Hewes & Phillips, Spiral Geared, one head on rail, very fine modern Tool. Good as new
1 15 in. x 15 in. x 3 ft. Wilkinson. A1 condition
1 22 in. x 18 in. Blaisdell Crank Planer. Good as new
1 24 in. x 24 in. x 5 ft. Whitcomb Planer. Good order

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1 4 in. Hubbert & Rogers Cutting Off Machine. A1 condition
1 20 in. Prentice Bros. Drill, Wheel Feed, with Chuck. Good order
1 20 in. Reed Drill, Lever Feed, with Chuck. Good as new
1 3 Spindle Barnes Drill Press. Good as new
1 No 1 2-Spindle Garvin Drill. Good as new
1 No. 2 4-Spindle Garvin Drill. Good as new
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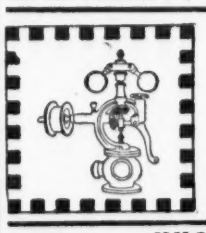

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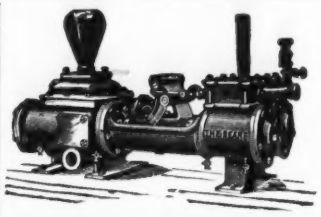

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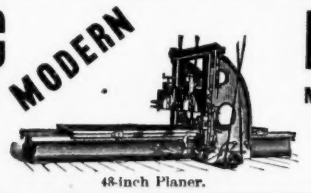

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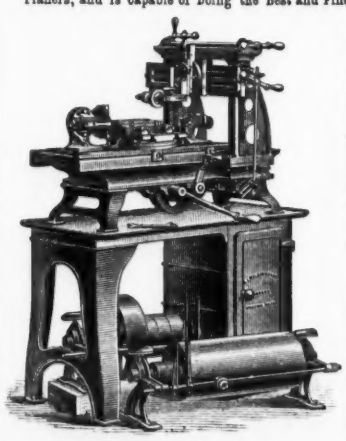

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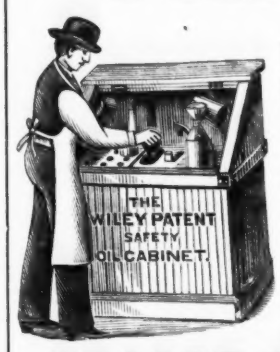

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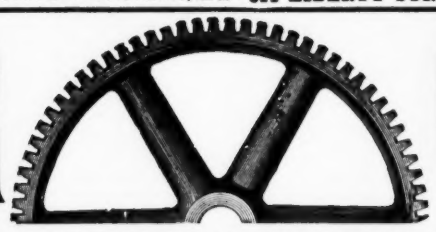

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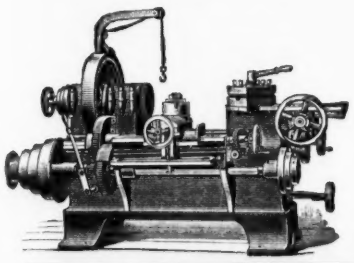

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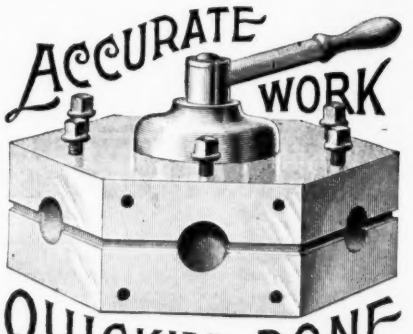

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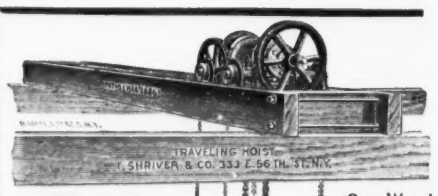

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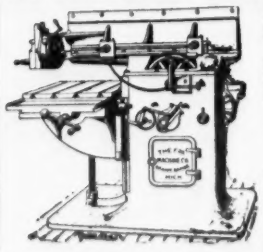

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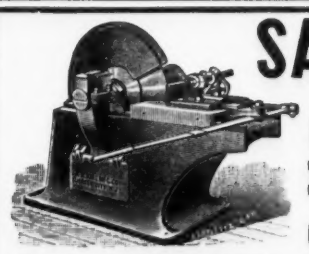

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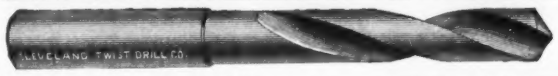

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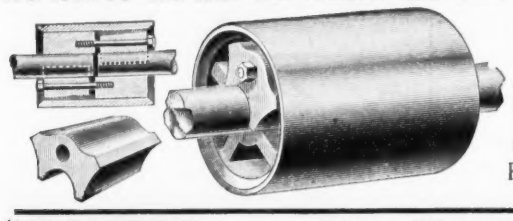

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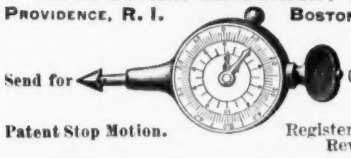

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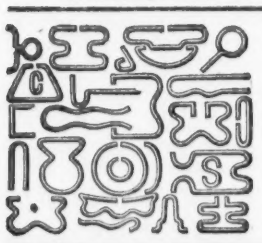

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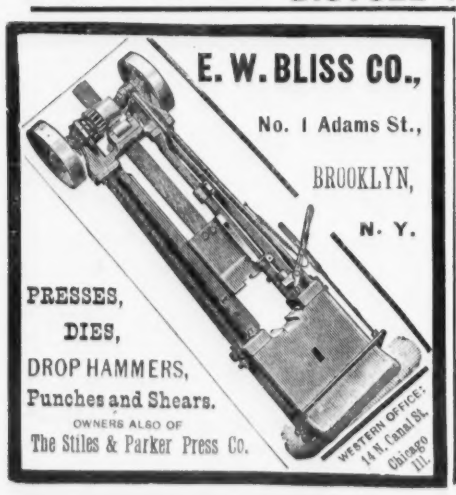

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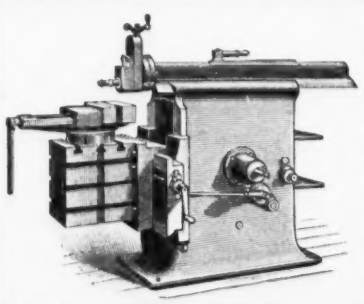

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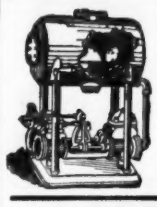

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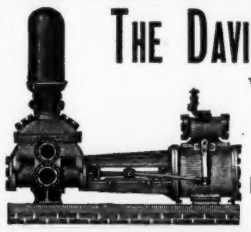

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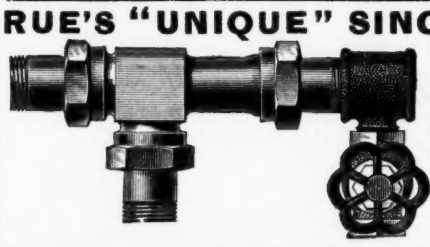

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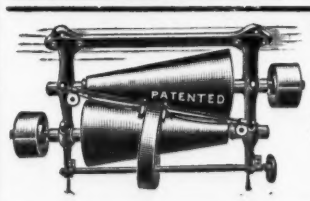

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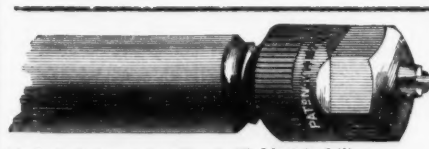

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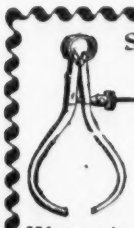

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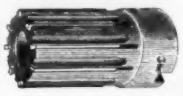
Adjustable  SHELL REAMERS

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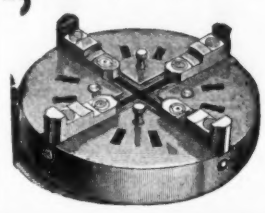

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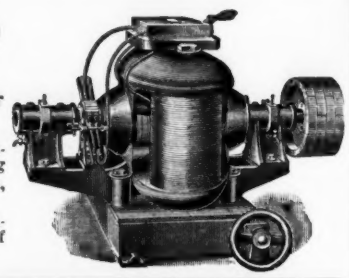

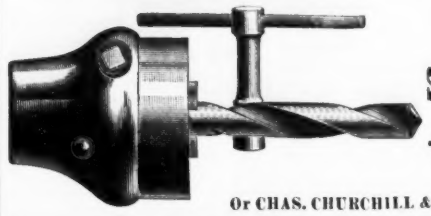

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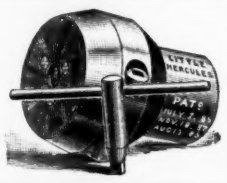

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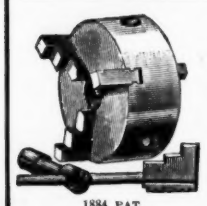
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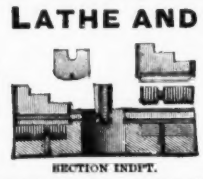
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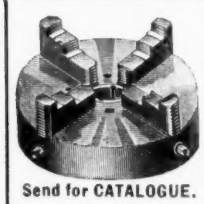

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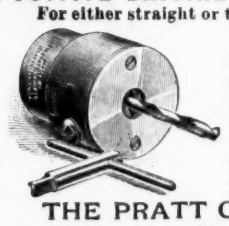

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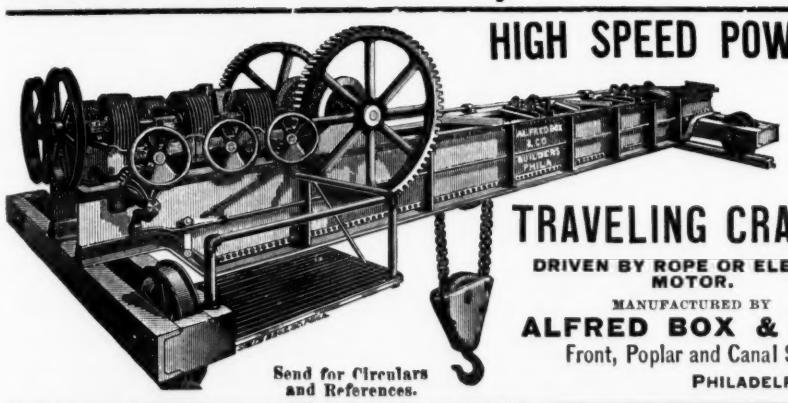

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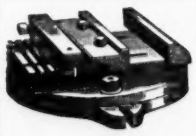

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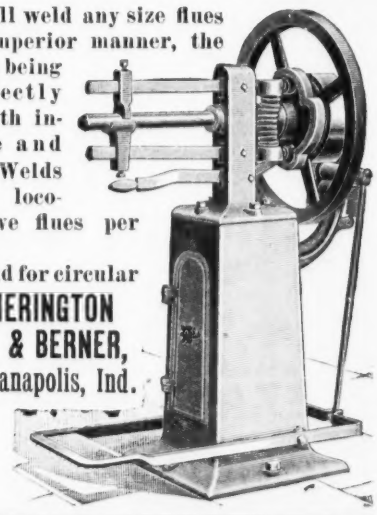

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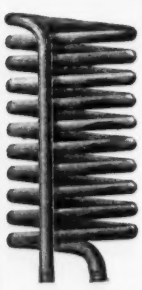

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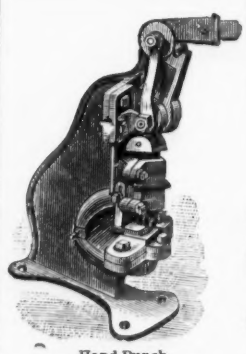

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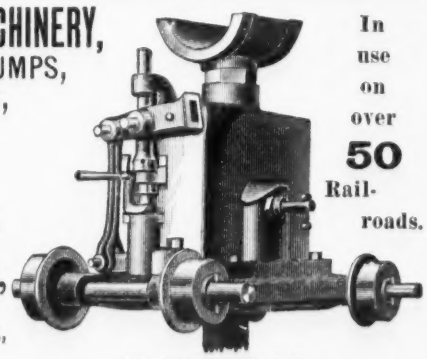

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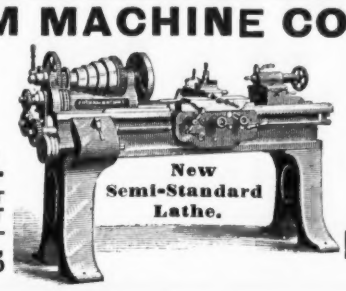

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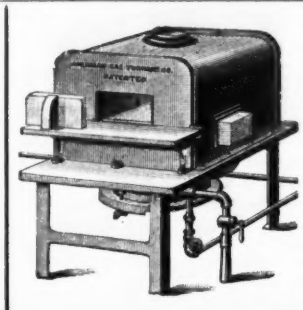

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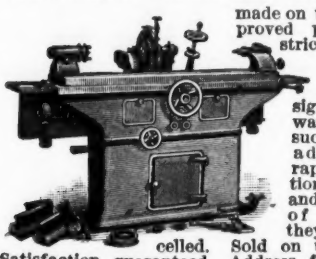

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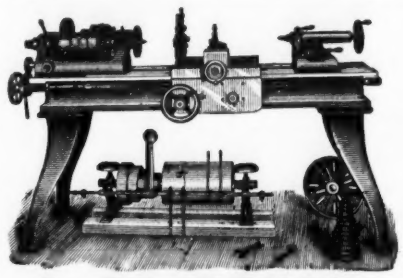

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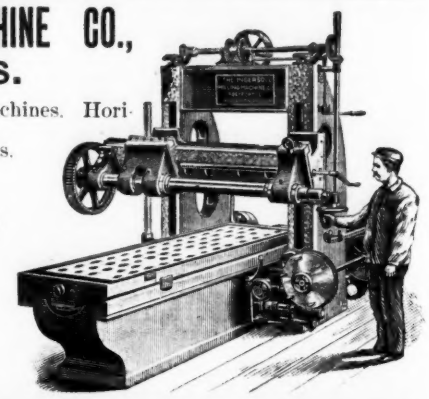

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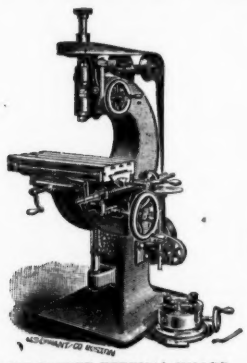

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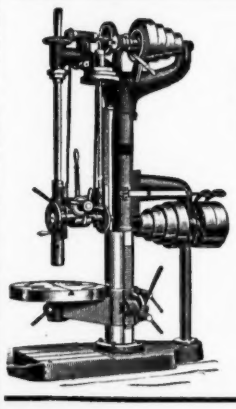

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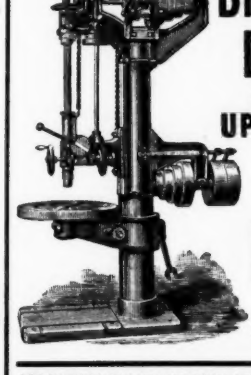

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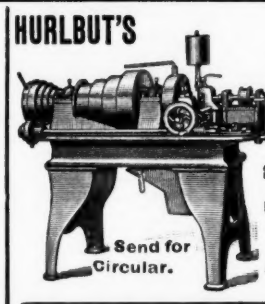

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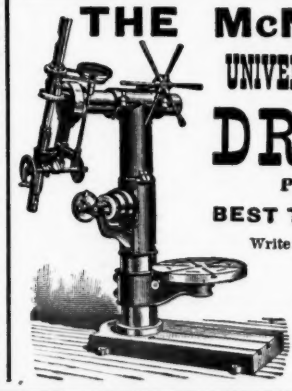

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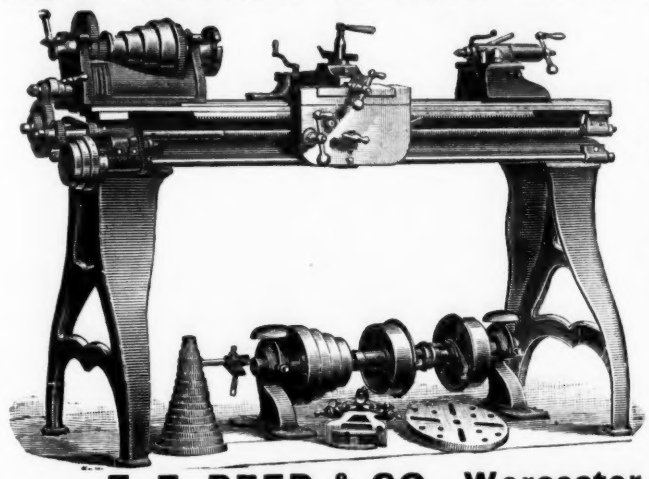

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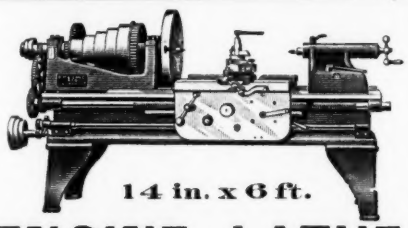

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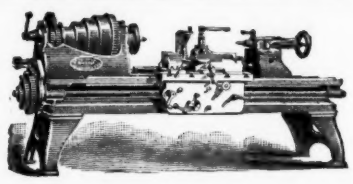

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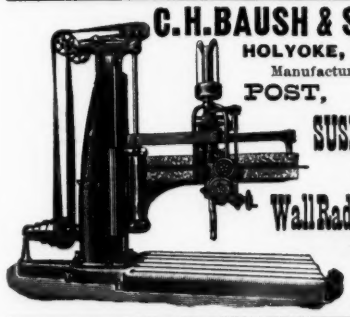

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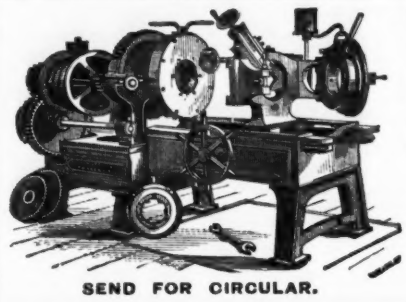

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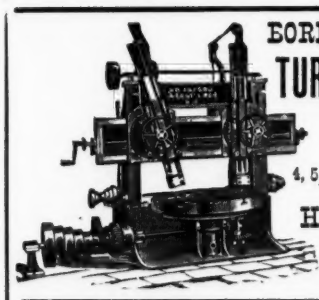

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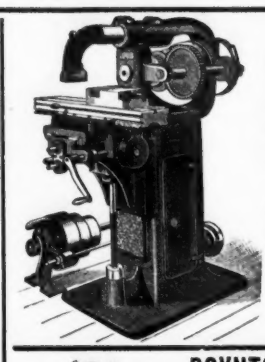

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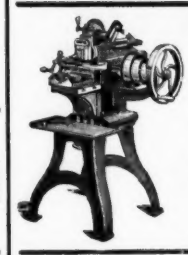

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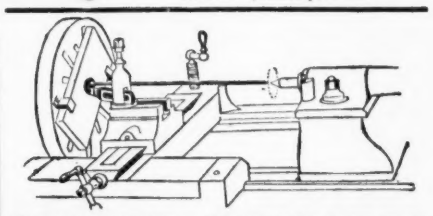

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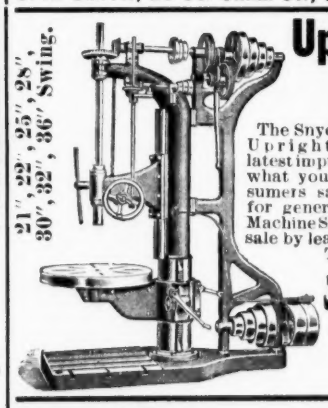

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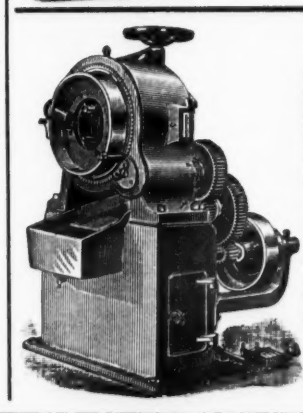

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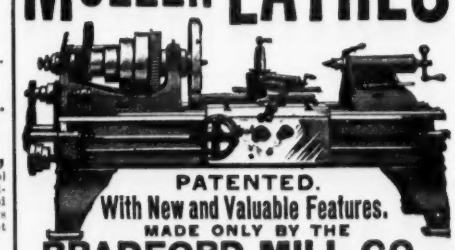

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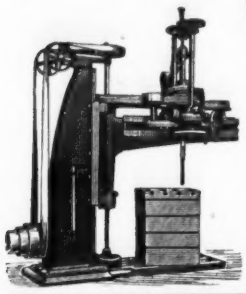

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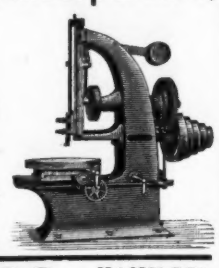

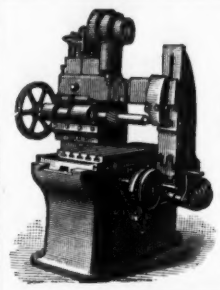

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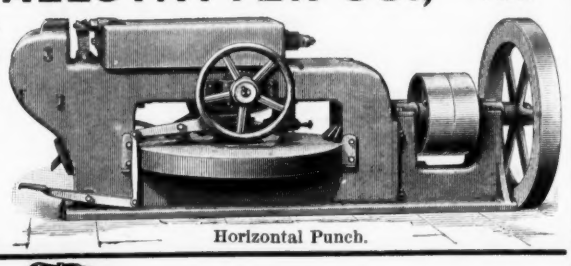
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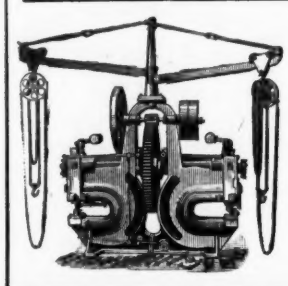

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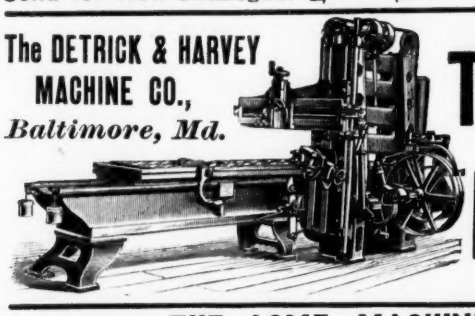

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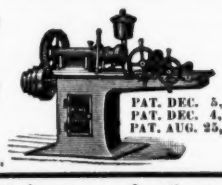
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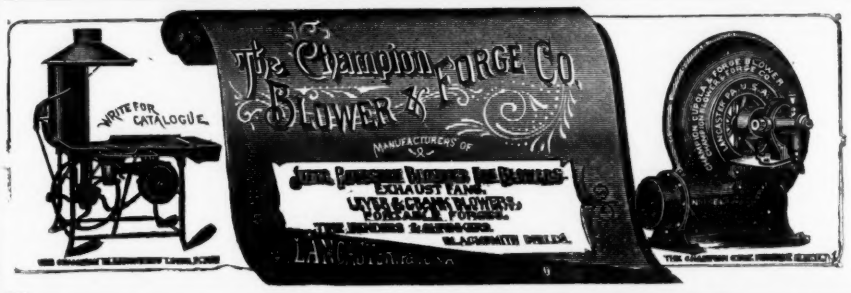
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1887.



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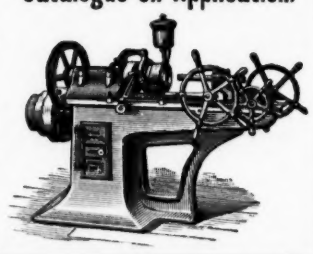

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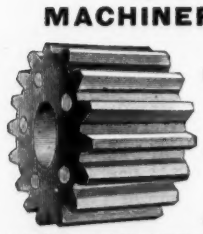

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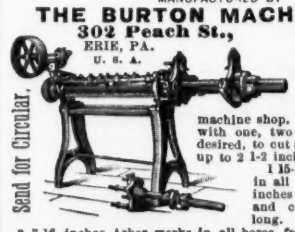
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2 7-16 inches Arbor works in all bores from 2 7-16 inches to 6 inches diameter, and cuts seats 16 inches long.
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With an attachment for the purpose seats can be cut in holes as small as 1 inch diameter, by one passage of the cutter.
If the work is heavy and too large to be placed on machine it can be detached from stand and used as portable machine.

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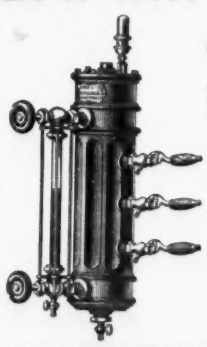
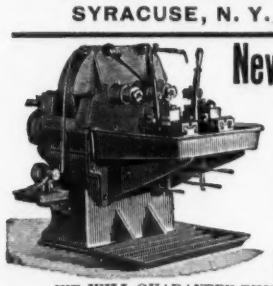
Protect your Boilers and your Lives.
Burn less coal, and have the satisfaction of feeling safe, by using
ASHLEY'S ALARM.
It will prove a good investment.



Ashley Engineering Co.,
136 Liberty Street,
NEW YORK CITY.
Agents wanted in every State.

New Automatic Solid Die BOLT THREADING AND TAPPING MACHINE.



WE WILL GUARANTEE THIS MACHINE TO do accurate BOLT THREADING more rapidly than any other machine made.
Changes from one size to another can be made in one minute.
No complicated head to get out of order.
BUILT IN 3 SIZES, 2, 4 AND 6 SPINDLE, BY
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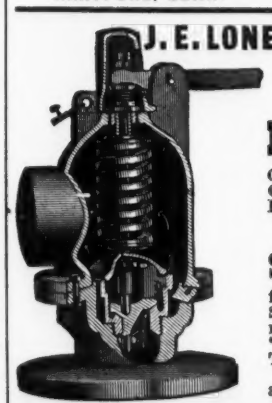

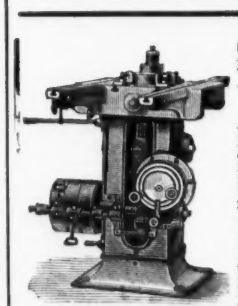

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The Falls Rivet & Machine Co., of Cuyahoga Falls, O., have a Key Seater made by another firm, say the Giant is the best Key Seater on the market. The Marinette Iron Works at West Duluth, experienced with other Key Seaters, say the Giant is superior in every respect. L. H. Brightman, Pres. Brightman Machine Co., Cleveland, Ohio, says he is personally familiar with the principal Key Seaters, and that the Giant leads them all.
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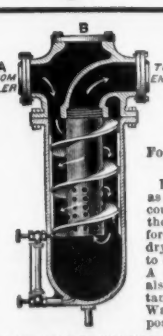

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Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.
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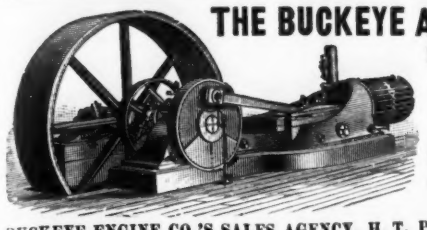

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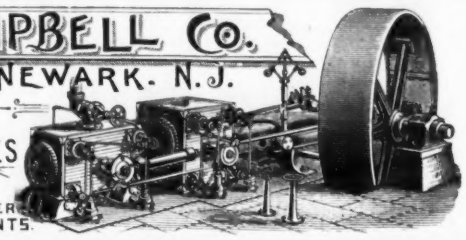

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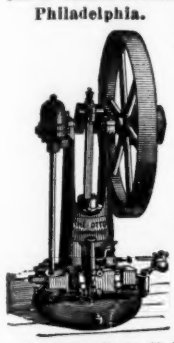

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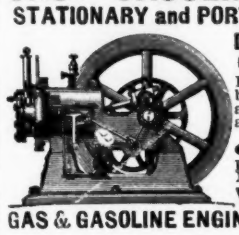

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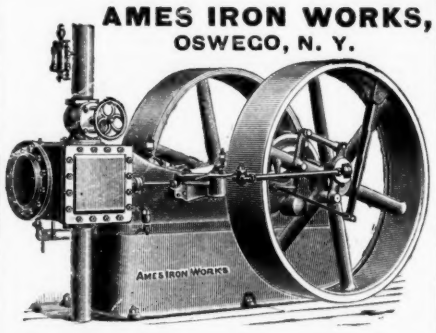

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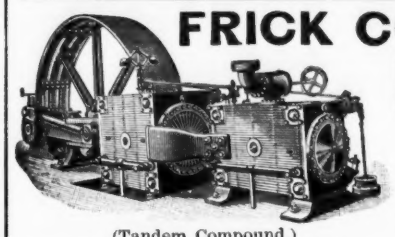

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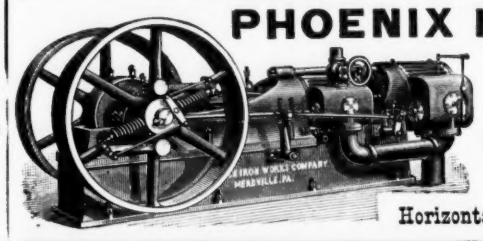

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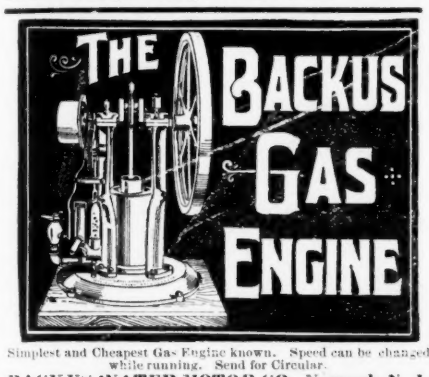

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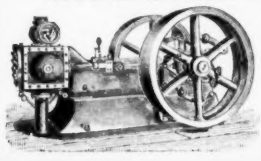

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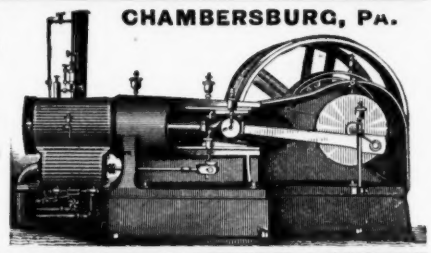

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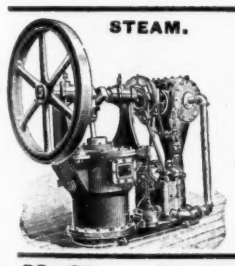

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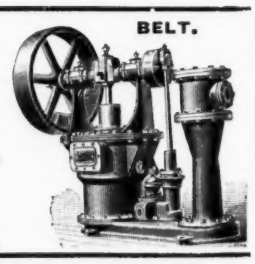

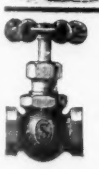

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Fig. 200.

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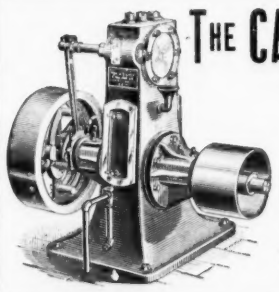

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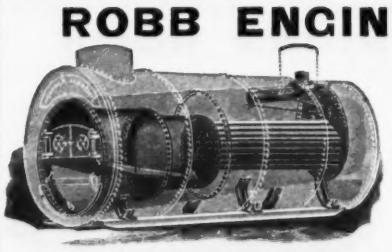

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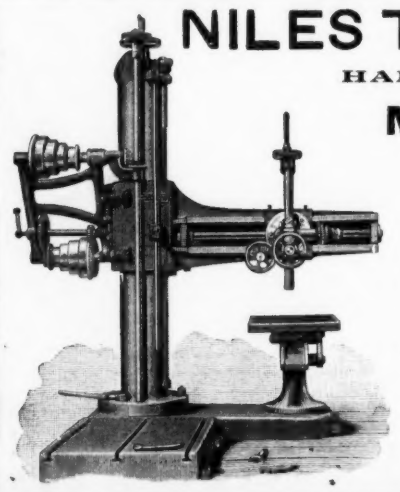

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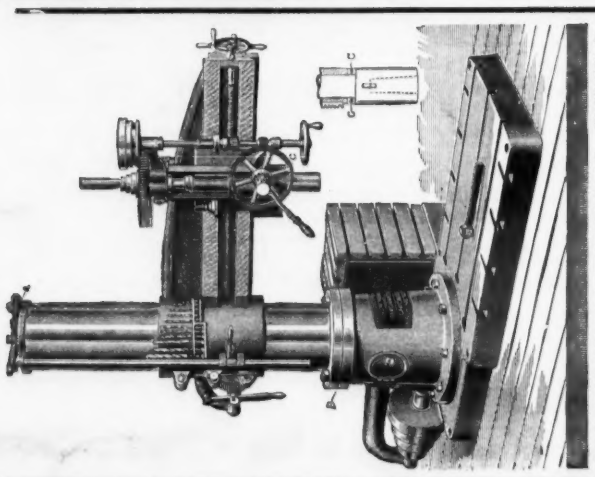

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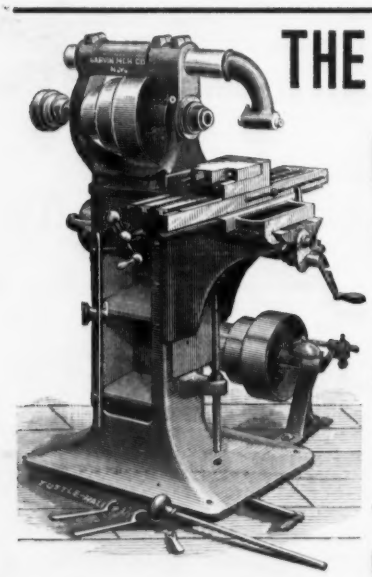

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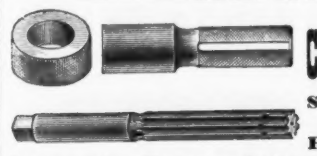

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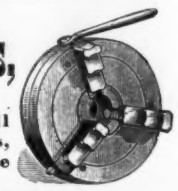

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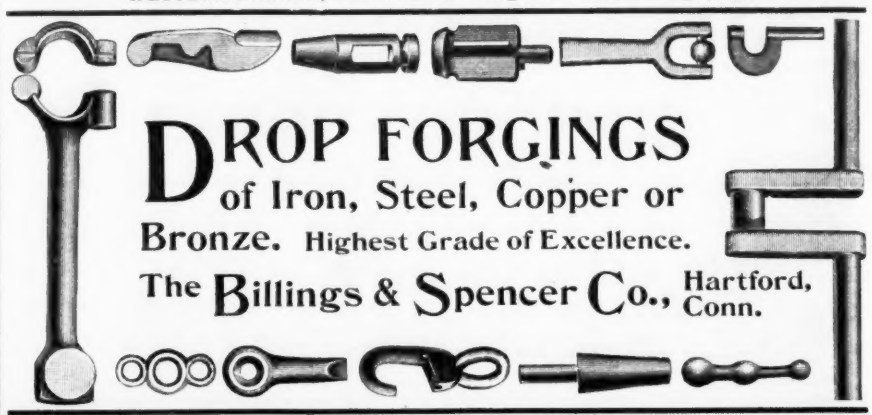

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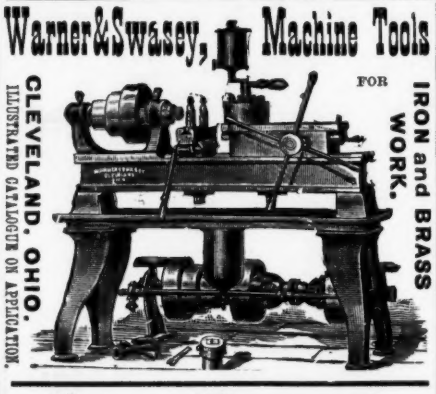

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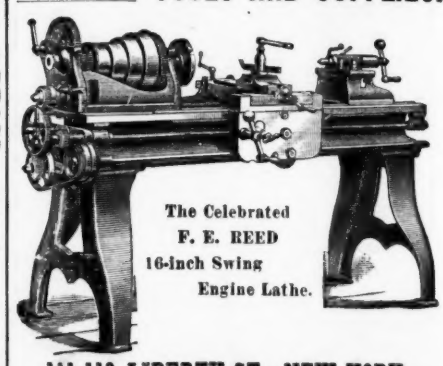

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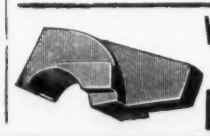

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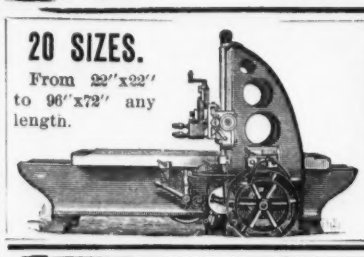

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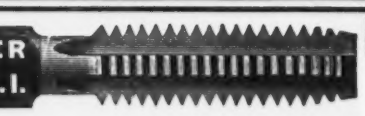

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